L'APPAREIL DE L'ARCHITECTURE MODERNE: NEW MATERIALS AND ARCHITECTURAL MODERNITY IN FRANCE, 1889-1934

by

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v. I

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ABSTRACT

This dissertation is an historical inquiry into the role played by new building materials in the formation of architectural modernism in France. It proceeds on the theoretical assumption that a "material" is not a technical given -- a securely defined entity in the physical and linguistic senses -- but an architectural construct whose "inherent properties" are a matter of interpretation. It suggests that within a specific architectural culture, the conceptions and uses of a material are defined by concerns that are not only constructional but involve architectural doctrines, building practices, aesthetic projects, and cultural strategies.

Since the publication of Sigfried Giedion's Bauen in Frankreich. Bauen in Eisen. Bauen in Eisenbeton (1928), reinforced concrete has been commonly accepted as the common denominator of French modernism. The dissertation questions this interpretive assumption, focusing on the changing conceptions of the material as an index of transformations in French architecture and architectural culture. It covers a period that spans from the Universal Exhibition of 1889 to the early 1930s, a period which saw the development of reinforced concrete in French architecture, from its emergence within architectural discourses to its inscription within early modernist historiography.

Through a close examination of contemporary books and periodicals, unpublished sources, and graphic documents, the dissertation explores the theories and works that framed the critical relationship of new material to French modernism. Inaugurated with the late nineteenth-century demise of metal as the leading material in architectural theory, the preeminence of reinforced concrete in French architecture was marked by the dispersion of rationalist tenets into competing architectural programs. The First World War was a pivotal event in this process.

Of principal importance were the positions of Auguste Perret and Le Corbusier. While Perret insisted on continuity with prewar practices, emphasizing the role of craft production, Le Corbusier embraced the rupture brought about by the *société machinique*, shifting towards the idea of industrialized construction. These positions were key to the technical and aesthetic definition of the modern house, from the function of the concrete frame to the nature of external revetments. They also led the way to the cultural and ideological debates that ensued on the nationality of the material and the sources of modern architecture. In the late 1920s the return of metal merely underscored the "rhetoric of materials" in the definition of French modernism.

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INTRODUCTION

Most historical accounts of twentieth-century architecture have emphasized the crucial role played by reinforced concrete in the development of French modernism. In these narratives, projects such as Auguste Perret's apartment building at 25bis rue Franklin in Paris (1903-04), Tony Garnier's project for a *Cité industrielle* (1901-04), and Le Corbusier's Dom-ino house (1914-16) are presented as icons of an emerging modernity. What links these projects is their conspicuous, if not innovative use of concrete. Their architects, moreover, are thought to have shared the belief that this new building material could open the way for a renewal of architecture. The new architecture thus came to be portrayed as the result of an evolutionary process fundamentally linked with the use of new materials.

Beginning with Bauen in Frankreich. Bauen in Eisen. Bauen in Eisenbeton (1928), and culminating with Space, Time, and Architecture (1941), the work of Sigfried Giedion has been most influential in the promotion of this interpretation. These early modernist narratives strongly insisted that modern materials played a determinant role in the development of the new architecture.[1] Almost twenty years later, Reyner Banham successfully challenged Giedion's approach in his Theory and Design in the First Machine Age (1960).[2] While recognizing the role of new materials and technology, Banham argues that modern architects did not fully exploit the means offered by the Machine Age but merely 'expressed' them in their designs. In his discussion of French modernism, Banham underscores the *mystique* surrounding reinforced concrete as well as

[1] Sigfried Giedion, Bauen in Frankreich - Bauen in Eisen - Bauen in Eisenbeton, Leipzig and Berlin, Klinkhardt & Biermann, 1928. [English translation: Building in France, Building in Iron, Building in Ferroconcrete, intro. by Sokratis Georgiadis, trans. by J. Duncan Berry, Santa Monica, The Getty Center for the History of Art and the Humanities, 1995]; Space, Time and Architecture: The Growth of a New Tradition, Cambridge (Mass.), Harvard University Press, 1941.

[2] Reyner Banham, Theory and Design in the First Machine Age, London, The Architectural Press, 1960. As early as 1941, John Summerson would put into question the causal relationship between "new materials" and "modern architecture". Rejecting such determinism, he argued that modern materials could only facilitate the production of modern forms. John Summerson, "The Mischievous Analogy", Heavenly Mansions and other Essays on Architecture, New York, W. W. Norton, 1948.

the deterministic discourse of many writers.[3] He explains this equation by the strong rationalist tradition in French architecture, which fostered the view of technique as a prime cause of style. Within this framework, Auguste Perret is viewed as an influential precursor of French modernism through his use of reinforced concrete, for he "advocated the trabeated structural frame later adopted by modernist architects", and "left concrete an aesthetically acceptable material."[4] For Giedion and Banham, the material is taken as a technical given, both writers adopting a position that is typical of attitudes toward the role of building materials in the study of modern architecture. Between the loose determinism of Giedion's interpretation, and the relativism of Banham, a broad territory was laid open for scholarly investigation.

Peter Collins's book Concrete: The Vision of a New Architecture (1959) was the first study to examine the specific role of a building material in the genesis of modern architecture.[5] The book opens with an elaborate history of the material, and then focuses on Perret's achievements.[6] Here, the architecture of Perret is presented as the teleological fulfillment of a technical development. For Collins, the French rationalist tradition finds its most perfect synthesis in Perret's architecture of reinforced concrete. Framed within the confines of Perret's own doctrine, this interpretation tends to dismiss all other approaches to the use of concrete in architecture, obscuring the broader relationship between the material and the development of French modernism.

The recent availability of archival sources has encouraged new studies and interpretations on the topic.[7] Gwenaël Delhumeau's work on the history of reinforced

[3] Banham writes: "So powerful was the mystique of reinforced concrete in Paris by about 1920 that many French writers have accepted the idea that the new architecture of the twenties was in some way caused by this one material, rather than facilitated by it. This acceptance of Choisy's view of technique as a prime cause of style, was doubtless encouraged by the dominating position of Perret as the sole innovator of consequence in the years immediately before the War..." Banham (see note 2), p. 202.

[4] Banham (see note 2), p. 38.

[5] Peter Collins, Concrete. The Vision of a New Architecture, London, Faber & Faber, 1959.

[6] For an account on the genesis of Collins' book, see my afterword to the French edition: Splendeur du béton: Les prédécesseurs et l'oeuvre d'Auguste Perret, Paris, Hazan, 1995, pp. 535-547.

[7] Several important collections, among them the archives of the Hennebique firm and of the Perret brothers, were made easily accessible with their transfer to the Centre d'Archives d'Architecture du XXe siècle of the Institut Français d'Architecture (IFA) in Paris. Established in 1986, the Centre d'Archives has

concrete in France between 1890 and 1914, a study primarily based on the archive of the Hennebique firm, is a case in point.[8] Placing Hennebique at the focal point of his investigation, Delhumeau constructs a history on the basis of a series of thematic investigations: the "invention" of the building system, the development of a building firm, the relationship between architects and builders, the confrontation between competing systems and actors (builders vs engineers), and the development of technical regulations.[9] Confining his study to a reconstruction that focuses on the careful deciphering of written sources, Delhumeau's narrative rarely ventures into the discussion of graphic documents, built projects, or historical interpretations, in the end avoiding any real discussion of the role of reinforced concrete in the development of French architecture. Therefore, though useful as a history of the material's inscription within the French building industry, Delhumeau's work offers little insight into the historiography of French modernism.

Another recent study on the history of the material and its embodiment in architecture is Cyrille Simonnet's doctoral dissertation on the origin, invention, and aesthetic of reinforced concrete.[10] Simonnet has brilliantly woven together an interpretation of the technical, social, and architectural construal of the material from the early 1800s to the 1930s. While basing his study on a variety of primary and secondary sources, the author tends to disregard the specific historical and architectural contexts of the archival material, thus refraining from a discussion of contemporary discourses on French modernism. The end result -- a collection of fragments rather than a continuous

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collected more than 200 archival *fonds*. The role of the Centre d'Archives is to facilitate the conservation and consultation of archives, and interpretation of 20th century French architecture. See Maurice Culot et al., Archives d'architecture du vingtième siècle, vol. 1, Liège, Mardaga, 1991.

8 The Centre d'Archives facilitated the consultation of the Hennebique archive previously housed at the Conservatoire National des Arts et Métiers (CNAM) in Paris under the auspice of the Centre de Recherche et de Documentation d'Histoire Moderne de la Construction (CRDHMC) supervised by Henri Poupée.

9 Gwenaël Delhumeau's work on Hennebique was presented as a doctoral dissertation in Art History at the Sorbonne (Paris), a work completed in fall 1995. Though I have not read the final manuscript, I do have a good knowledge of the author's approach from our extensive discussions and research collaborations on the subject at the Centre d'Archive of IFA.

10 Cyrille Simonnet, "Matériau et architecture. Le béton armé: origine, invention, esthétique", 3 vols., doctoral dissertation, Paris, E.H.E.S.S., January 1994.

narrative -- resembles a general theory of the material, not a history of its inscription within a specific architectural culture.[11]

These studies generally disregard the fact that a "material" is not a technical given -- a securely defined entity in the physical and linguistic senses -- but an architectural construct whose "inherent properties" are a matter of interpretation. Recent debates in the history of technology have emphasized that technological artifacts are "social constructions".[12] Like any technological artifact, reinforced concrete must be studied as a construct that merges technical, architectural, and cultural agendas, and whose "nature" may vary according to the context and conditions of its apprehension.

To approach this material as an "architectural construct" is to suggest that within a specific architectural culture, the conceptions and uses of a material are defined by concerns that are not only constructional but involve architectural doctrines, building practices, aesthetic projects, and cultural strategies. As such, it implies that an "architectural" history of the material necessarily entails a direct confrontation with the historiography of modernism. To write this history not only requires the historian to investigate primary sources; it requires the historian to engage in a discussion of current historical interpretations.

This dissertation is an historical inquiry into the role played by new building materials in the formation of architectural modernism in France. Its covers a broad period extending from the Universal Exhibition of 1889 to the early 1930s, a period that encompasses the development of reinforced concrete in French architecture, from its emergence within architectural discourses to its inscription within early modernist historiography. Reinforced concrete has been conventionally presented as the common

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[11] As a general theory, Simonnet's work recalls Alain Guiheux's study on the use of brick in architecture, from Alberti's formulations to Kahn's applications. Exploring the interaction between a material and its embodiment within various building cultures, Guiheux shows that the conception and use of a material in architecture can convey a rich and complex set of meanings. Alain Guiheux, L'ordre de la brique, Bruxelles, Mardaga, 1985.
[12] Wiebe E. Bijker, Thomas P. Hughes, Trevor J. Pinch, eds., The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology, Cambridge, MIT Press, 1987.

denominator of French modern architecture. Though its emergence was of primary importance in the formation of French modernism, the historical conceptions of this material (with its peculiar ambiguities) and the nature and range of its influence have never been adequately examined.

Historiographic issues

An investigation of the role of building materials in French architecture necessarily entails a discussion of architectural rationalism. The most forceful exposition of the rationalist program was to be found in the works of Viollet-le-Duc.[13] In his pioneering study on Viollet-le-Duc, Robin Middleton has shown how the work of the nineteenth-century writer fits into the longer French rationalist tradition, a tradition he traces back to early French interest in the structural interpretation of Gothic architecture.[14] As such, Middleton demonstrates how rationalism was a constant element in French architectural theory for 250 years. For Viollet-le-Duc, structural and material considerations, as well as the demands of social and ritual use, were viewed as the determinants of form. This analytic relationship between materials, construction, and form was to be called Structural Rationalism. It advocated the truthful use of materials, and sought the adequacy between construction and ornamentation.

Despite the thoroughness of its textual and graphic formulation, Viollet-le-Duc's doctrine was not devoid of internal contradiction. While mostly preoccupied with reason and logic in architecture, Viollet-le-Duc also maintained that the work of the architect was to "make appear", to "give appearance". The main design task was therefore to try to

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[13] See Eugène-Emmanuel Viollet-le-Duc, Dictionnaire raisonné de l'architecture du XIe au XVIe siècle, Paris, A. Morel, 1854-68. The various architectural responses to the call for the rational use of modern materials were to address, and be fashioned by, these premises and their internal contradictions.
[14] Beginning with his doctoral dissertation, "Viollet-le-Duc and the Rational Gothic tradition" (Cambridge, 1958), Robin Middleton has played a pioneering role in the re-reading of Viollet-le-Duc's rationalism. For a brief overview of his interpretation, see especially R. Middleton, "The Rationalist Tradition in France", in Neoclassical and Nineteenth Century Architecture, by R. Middleton, D. Watkins, New York, Harry N. Abrams, 1980.

reconcile reason and the visible, to render the structure visible.[15] This deep-seated dualism put the rationalist definition of architectural truth into a state of permanent crisis. Architectural truth -- both ethic and aesthetic -- was to waver between the legibility of structures and the visibility of materials; between the real and the apparent.

The basic premises and inherent contradictions of Viollet-le-Duc's rationalism were to pervade French theory and criticism from the turn of the century until the early 1930s. They were to reappear in a number of different and often competing architectural programs. These rationalist premises would be used both for the development of specific doctrinal programs and for the formulation of retrospective interpretations. The various architectural responses to the call for the rational use of modern materials were to address, and be fashioned by, these premises and their internal tensions. Although my study is not a history of rationalism in French architecture, it naturally entails an appraisal of the transformation in the discourse of rationalism. It suggests that the architect's changing conceptions of reinforced concrete are indicative of transformations in French architecture and architectural culture, revealing the continuities and discontinuities in rationalist discourse.

This study also addresses the issue of periodization in the interpretation of French modernism. The modernist concern for new materials is generally understood as a continuation of the prewar rationalist reading of architecture. Banham's interpretation exemplifies this position. Emphasizing the importance of the rationalist point of view, Banham sees an unbroken continuity between nineteenth-century positivist inquiries (Auguste Choisy) and the modernist discourses of the 1920s. At the same time Banham also locates the emergence of an authentic modern architecture in the postwar period, thus relegating the prewar period to the status of a merely preparatory phase. The continuity of rationalist discourse is offset by a discontinuity in programs and forms. Within this framework, the war is a pivotal event in the course of French architecture, but the exact

[15] For an analysis of the contradiction between reason and the visible in Viollet-le-Duc's theory, see Hubert Damisch's introduction to E.-E. Viollet-le-Duc, l'architecture raisonnée, Paris, 1964.

nature of the changes remain unexplained. In his important study on French modern art, Kenneth Silver demonstrates that the war did have a major role in how the art of the Parisian avant-garde evolved and was interpreted, revealing how prewar avant-garde art, and especially cubism, came to be viewed as cosmopolitan and decadent during the war years.[16] This nationalist criticism paved the way for a *retour à l'ordre* in artistic practices, a *retour à l'ordre* that -- according to Gérard Monnier -- was also felt in the realm of architecture.[17] But in the absence of any compelling evidence of prewar avant-garde practices in architecture, this return to order appears paradoxically as the starting point of French modernism.[18]

Confronting this issue of periodization, my study investigates the impact of the war on the conception and production of the new architecture. By compelling architects to address and adapt to the new industrial reality, the war precipitated the development of new attitudes towards building materials and techniques. I argue that these new conditions transformed the dialectical relationship between architecture and construction, and challenged the conventional tenets of French rationalism.

An outline

With these issues in mind, I have divided my analysis into seven chapters. The first two chapters examine the technical and theoretical inscription of reinforced concrete within French architectural culture between 1889 and the first World War. The third chapter covers the period from 1914 to the early 1920s, and investigates the impact of the war and postwar reconstruction on the conception of modern materials and techniques. The last four chapters, which span the period from 1923 to the early 1930s, examine the question

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[16] Kenneth Silver, Esprit de corps: The Art of the Parisian Avant-Garde and the first World War, 1914-1925, Princeton, Princeton University Press, 1989.

[17] Gérard Monnier, "Un retour à l'ordre: architecture, géométrie, société", Actes du colloque Le retour à l'ordre (1919-1925), Saint-Etienne, C.I.E.R.E.C. - Université de Saint-Etienne, 1975.

[18] This interpretation is reinforced by Monnier's periodization which emphasizes the postwar period as the beginning of French modernism. See Gérard Monnier, L'architecture en France: une histoire critique, 1918-1950, Architecture, culture, modernité, Paris, Philippe Sers Editeur, 1990.

of modern materials in the context of postwar modernist practices and discourses. Though organized chronologically, the chapters do not attempt to provide a complete and continuous history of the material or of its architecture, but taken together they offer a substantial reappraisal of the role played by modern materials in the constitution of French modernism.

My research is based on the investigation of published material: architectural treatises and essays, technical handbooks, and trade catalogues, as well as construction, architecture and art periodicals. I have also examined unpublished material including manuscripts, correspondence, and scrapbooks preserved in the archives of architects and building firms (Auguste and Gustave Perret, Paul Guadet, Joachim Richard, Charles-Henri Besnard, Le Corbusier, André Lurçat, and the Hennebique firm); and written and graphic documents pertaining to buildings and projects by Auguste Perret and the Perret brothers firm, Le Corbusier and Pierre Jeanneret, André Lurçat, and Robert Mallet-Stevens.

The first chapter of the dissertation focuses on the *beginning* of reinforced concrete in French architecture. Moving away from the search for origins in the material itself, I situate this beginning within the realm of architecture. The new building system disrupted current doctrinal and stylistic discourses, and gave rise to unexpected arguments about the visibility and concealment of materials in architecture. These theoretical constructs were framed by the current debates on iron architecture. The chapter shows how the emergence of reinforced concrete led to the demise of iron as the leading material in architectural theory. It also considers how the adoption of reinforced cement by the rationalist school led to mutations within the rationalist doctrine itself.

The second chapter examines the use of reinforced concrete in Parisian architecture, paying special attention to the debate on the relationship between the wall, the frame, and the revetment. Focussing on Auguste Perret's apartment building at 25bis rue Franklin (1903-04) and Anatole de Baudot's church of St-Jean-de-Montmartre (1896-1904), the chapter investigates how the conception of the modern wall and the dialectical relationship between tectonics and ornamentation weighed heavily on the search for architectural expression. Challenging accepted interpretations that regard the decoration of early reinforced-concrete buildings as concessions to Art Nouveau taste, I argue that the adoption of ornamental facing concurred with contemporary conceptions of the building system. Perret's treatment of reinforced concrete at the Champs-Elysées theater (1911-13) was a clear indication of the transition from ornamental facing to monumental cladding, as well as being a project that confirmed the architect's search for the *representation* of the concrete frame.

The third chapter examines the impact of the war and reconstruction on the conception of modern materials and techniques. I argue that the industrial model, both in its architecture and in its systems, put a revision of ideas about construction in terms of both process and aesthetic into motion. Focusing on the working practices of Auguste Perret and Le Corbusier, the chapter shows how the new context of production encouraged the fragmentation and dispersion of rationalist tenets into different programs. Perret's emphasis on craft production is contrasted with Le Corbusier's embrace of industrial processes. Within Le Corbusier's practice alone, it is clear that the rationalist principle of truthfulness in the use of material underwent a shift from a concern for external appearance to the production process itself.

The fourth chapter discusses the role given to reinforced concrete in the definition of a French modern architecture, focusing on the evolving doctrinal approach of Auguste Perret between 1923 and 1927. In 1923 -- a year significant for both the inauguration of Perret's Raincy church and the publication of Le Corbusier's Vers une architecture -- reinforced concrete was largely identified with the modernization of construction and the aesthetic renewal of architecture. Yet by the end of the period, Perret and his circle -- a group of art critics -- were actively engaged in the definition of the *architecture du béton armé*. Perret's work and doctrine thus became an attempt to bridge the modernization of construction and the French architectural tradition, a cultural project that led to the reconception of reinforced concrete as a kind of modern stone.

The fifth chapter discusses the links between reinforced concrete and the aesthetic of the modern house, covering the period from the first formulation of the new architecture in the early 1920s to the codification of its aesthetic at the end of the decade. The chapter considers the impact of various architectural exhibitions held between 1922 and 1924 on the formal definition of the new architecture; an architecture that came to be enshrined in the type of undecorated cubic house in reinforced concrete. It then examines the role of the material in the actual construction of the modern house. Examining the execution of houses by Auguste Perret, Robert Mallet-Stevens, André Lurçat, Le Corbusier and Pierre Jeanneret, this chapter explores the conventions, constraints, and innovations at work in the use of reinforced concrete. Paying close attention to how the concrete frame was conceived and implemented by various architects, I show that differences in working practices were not solely technical, an analysis which in turn provides clues about the conceptual process and the sources of the aesthetic project itself.

In the sixth chapter, I compare the roles ascribed to new materials by Perret and Le Corbusier in their competing definitions of architectural modernism. Presented as the true *architecture du béton armé*, Perret's work was framed by contemporary critics as a practice that achieved "truth to materials". This chapter examines Perret's call for the "visibility of materials" (marked by the development of infill panels in concrete), and his campaign against the use of coating in modern architecture. The following section examines the role Le Corbusier gave to reinforced concrete in the codification of the new aesthetic. Based on a careful analysis of the gradual definition of the Five Points, I show how Le Corbusier developed his conception of the house as a system which merged the constructional with the formal. Overcoming the conventions of structural rationalism, Le Corbusier defined principles which took precedence over the material itself, encouraging a shift toward the use of the metal frame and the realization of the *maison à sec*.

The final chapter examines the emerging relativism regarding structural and revetment materials in the early 1930s. It focuses on the return of metal -- seen in the rise of the metal-framed house in French architecture -- along with a growing interest among architects in the question of external revetments. With the example of Le Corbusier's strategic combination of the metal-frame with natural revetment materials, I argue that the new relativism of materials must be understood not as a rejection of the industrialization of construction, but as a continuation of that project. I further explore this issue in light of the nationalist campaign in the early 1930s against reinforced concrete and Modern architecture, a campaign that highlighted the opposition between Perret's support of traditional craftsmanship and Le Corbusier's defence of industrialized construction.

Significance for the field

Since research for this dissertation was begun, a number of studies have explored the tectonics of modern architecture.[19] While the discussion of tectonics has for the most part concentrated upon the theoretical works of key German and Viennese architects, it has recently taken both new directions and new dimensions.[20] In Studies in Tectonic Culture (1995), Kenneth Frampton explores the place and role of tectonics in modern architecture, grounding and providing a poetic program for contemporary architecture.[21] The critical reception of Frampton's project has revealed the richness and diversity of topics related to the historical and theoretical investigation of tectonics in architecture.[22] Fostering an examination of architecture in relation to its origin in "buildings", studies in tectonics are

[19] This renewal of interest is undoubtedly related to the recent availability in English of a number of works on nineteenth-century German architectural theory published in the "Texts & Documents" series of the Getty Center for the Arts and the Humanites (now the Getty Research Institute for the Arts and the Humanities).

[20] On the question of tectonics in German architectural theory, see especially: Otto Wagner: Reflections on the Raiement of Modernity (ed. by Harry Francis Mallgrave), Santa Monica, The Getty Center for the Arts and the Humanities, 1993; Werner Oeschlin, Stilhülse und Kern: Otto Wagner, Adolf loos und der evolutionäre Weg zu modemen Architektur, Zurich, gta/Ernst & Sohn, 1994.

[21] Kenneth Frampton, Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture (ed. by John Cava), Cambridge-London, The MIT Press, 1995.

[22] See "Tectonics Unbound", thematic issue of ANY, no. 14, January 1996. For a critique of Frampton's project, see especially Mitchell Schwarzer's introduction, pp. 13-15.

concerned at once with issues of construction, technology, and building materials. These studies bring to the fore the fact that building materials are architectural means endowed with symbolic and cultural meaning.[23]

Exploring issues that are germane to these contemporary studies on materials and tectonic culture, my dissertation also points to the need for an examination of new materials within specific national contexts. It argues that in Europe, the widely shared preoccupation of modern architects for new building materials and techniques may have obfuscated differences in interpretation rooted in particular national settings. The universal concerns of the Modern Movement for technology were echoed in discourses and forms which primarily addressed local debates and practices. My analysis suggests that in France the uses and meanings of reinforced concrete in architecture were shaped at once by technical, cultural, and ideological agendas.

The dissertation also contributes to ongoing studies on the development of modernist practices in French architecture. It explains the constitution of two determinant but divergent architectural programs: Le Corbusier's international modernism and Auguste Perret's *architecture du béton armé*. It further contributes to the discussion on the relationship of rationalism to architectural modernism. Though references to Viollet-le-Duc's rationalist doctrine are common in modernist literature, his impact on French architectural culture of the 1920s has so far received limited attention. The present study reveals how rationalist principles permeated the discourse of French modernism, and sheds light on the fate of the rationalist program in the early 1930s.

Finally, this study contributes to current reflection on the "materiality" of modern architecture. The existence of a work of architecture (not unlike those of painting and sculpture) derives from the particular way materials and means are brought into play. In

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[23] Of the recent studies that focus on the meaning of building materials, see especially: Thomas Raff, Die Sprache der Materialien: Anleitung zu einer Ikonologie der Werkstoffe, Munich, Deutscher Kunstverlag, 1994; "On materials", thematic issue of Daidalos, no. 56, June 1995; Akos Moravanszky, "'Truth to Material' vs 'The Principle of Cladding' - The language of materials in architecture", AA Files, no. 31, Summer 1996.

such works, the material acquires a character in which the technical and the metaphorical coalesce. My analysis may help in deciphering this "rhetoric of materials" in the practice and interpretation of modern architecture.

CHAPTER I

FROM THE METALLIC TO THE LITHIC: Iron, Reinforced Concrete, and French Architectural Culture (1889-1905)

With the Galerie des Machines and the Eiffel Tower, the 1889 Universal Exhibition in Paris conventionally epitomizes the triumph of iron in architecture. Celebrating the event, contemporary critics turned iron into the symbol of French industrial and technological progress, presenting it as the key material of the new architecture. By the turn of the century, however, metal had already suffered a serious eclipse, hidden behind the *staff* (a composite of plaster and plant fibers) or stone facades of the 1900 Exhibition pavilions. Although iron and steel remained largely in use, critics expressed great disappointment at the failure of metal to help develop a new architecture. This change in the perception of iron architecture was paralleled by the rapid emergence of a competing building system: reinforced concrete. With the immersion of an iron framework in a mixture of cement, the original properties of these hitherto distinct materials were suddenly overshadowed. Disrupting current doctrinal and stylistic discourses, this technical operation gave rise to unexpected arguments about truth and the visible in architecture.

Current historiographic approaches tend to study iron and reinforced-concrete architecture in France as two separate filiations or traditions, and the conceptual transition from one building material to the other remains largely unexplored. Moreover, historical investigations of reinforced-concrete architecture are often grounded in a retrospective history of the material, bypassing the problem of its "beginning" in architectural thinking.[1] In this first chapter, I examine this period of transition, insisting on the

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[1] In Concrete: The Vision of a New Architecture (1959), Peter Collins inaugurates his study with an exploration of the history of the material. Locating the source of modern reinforced concrete in the French 18th-century technique of *pisé* construction, Collins continues with the invention of the material: béton and concrete. Searching for the "origin" of reinforced concrete architecture in the material itself, this approach eludes the question of periodization, and of historical "beginning(s)". On the notion of "beginnings" as historical constructions, see Edward W. Said, Beginnings, Intention & Method, New York, Columbia Univ. Press, 1985.

necessity to study these two modern materials as products of a single building tradition, and as agencies constitutive of a unified architectural culture.

1. *L'art et le fer*

At the time of the 1889 Universal Exhibition, iron as a modern building material occupied the central place on the architectural scene. The architecture of the exhibition was enthusiastically received by most cultural critics, and iron was presented as the primary material of the new architecture to come. Though architects' responses were more critical, the event triggered a lengthy debate on the role iron could or should play in the future of architecture.

As an exhibition celebrating the centennial of the French Revolution, the fair of 1889 highlighted the major technological innovations and societal changes that had occurred over the previous hundred years.[2] Planned by Republican officials during the 1880s, the exhibition was to express the ideology of progress of the Third Republic. Its iron monuments -- the Eiffel Tower and the Galerie des Machines -- were to serve as symbols of the movement toward liberal democracy based on science and technology that had been initiated by the Revolution (fig.1). The critical reception of the fair's iron architecture was largely indebted to those visions of progress. A great number of publications celebrated the monumental iron structures as works announcing the beginning of a new era, a new "iron age".[3] Edouard Lockroy, a Republican official involved in the planning of the exhibition, discussed the role of iron in the birth of a modern style:

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[2] On the 1889 Exhibition, see Miriam R. Levin, When the Eiffel Tower was New: French Visions of Progress at the Centennial of the Revolution, Mount Holyoke College Art Museum, 1989; see also Debora Silverman, Art Nouveau in Fin-de-Siècle France: Politics, Psychology and Style, Berkeley and Los Angeles, Univ. of California Press, 1989.

[3] Gaston Chaumelin, L'avènement de l'âge du fer dans l'architecture, Le Mans, Edmond Monnoyer, 1889; see also: Albert de Lapparent, Le Siècle du Fer, Paris, Librairie F. Savy, 1890; A. Vierendeel, L'architecture métallique au XIXe siècle et l'exposition de 1889 à Paris, Bruxelles, 1890.

> Slowly, however, the modern style emerges, and it takes shape as industry and science put new materials and new techniques at our disposal. The more wrought iron and steel play a role in our construction, the more we will achieve our own distinctive effects. Their lines will combine differently from before; this is the art of the nineteenth century, of the twentieth century.... The 1889 exhibition has accelerated its birth.[4]

For the art critic Edouard Champury, the exhibition of 1889 had triggered and consecrated the development of a new art form: iron architecture.[5]

The architecture of the exhibition elicited a somewhat different response from the architectural community. Architects' critical reviews of the many pavilions were followed by discussions on the use of iron in architecture. Two major schools of thought were then dominating French architectural circles. These two schools -- Rationalism and Classicism -- were very active in the debate on iron and architecture.[6] Their respective positions were defended by Anatole de Baudot (1834-1915), editor of the Encyclopédie d'Architecture,[7] and Louis-Charles Boileau (1837-1910), editor of L'Architecture.[8]

Keen followers of Viollet-le-Duc (1814-1879), Anatole de Baudot and the Rationalists wanted to reform architecture through renewed attention to modern needs and modern techniques. For de Baudot, the development of a new architecture could hardly

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[4] Edouard Lockroy, quoted in E. Monod, L'Exposition Universelle de 1889, Paris, Dentu, 1890, vol. 1, pp. xxvi-xxvii (quoted in Silverman [see note 2], pp. 4-5).

[5] Champury wrote: "L'Exposition de 1889 fera date....elle a le mérite d'avoir permis, d'avoir même suscité l'affirmation définitive et la consécration par le succès d'une forme nouvelle d'art: une architecture de fer..." Edouard Champury, "Exposition Universelle de 1889 - La crise de l'architecture et l'avènement du fer", L'Art, vol. 15, no. 47, 1889, p. 49.

[6] The use of the term Rationalism is problematic. The genealogy of rationalist thinking in French architecture has triggered the formulation of competing interpretations. In my dissertation, I adopt Neil Levine's interpretation which locates the source of French rationalism in the ideas of the Romantic *pensionnaires* of the 1830s, and the work of Henri Labrouste (1801-75). Romantic rationalism was later to split into different tendencies. By the end of the nineteenth century, the two most vocal factions were the structural rationalists indebted to Viollet-le-Duc and the classical rationalists closer to the Ecole des Beaux-Arts. In this dissertation, I shall use the terms *Rationalism* and *Classicism* to distinguish these two approaches. See Neil Levine, "Architectural Reasoning in the Age of Positivism: The Neo-Grec Idea of Henri Labrouste's Bibliothèque Sainte-Geneviève", Ph.D. diss., Yale Univ., 1975, vol. 1, pp. 20-22.

[7] Founded in 1851, the Encyclopédie d'Architecture became a stronghold of the Rationalist school towards the end of the 1880s.

[8] Founded in 1888, L'Architecture was the organ of the Société Centrale des Architectes Français and affiliated with the all-powerful Ecole des Beaux-Arts. Another important contemporary architectural periodical was La Construction Moderne (1885-1939) edited by Paul Planat.

take place without the use of the materials made available by modern industry. Advocating the use of iron in architecture, he claimed that metal had to be used frankly and had to visually express its structural function.[9] Rejecting academic design conventions, he welcomed the slender proportions of iron-skeleton buildings and encouraged the use of exposed metal in an effort to achieve architectural "honesty". Yet the election of iron compelled the Rationalists to make a clear distinction between the *oeuvre calculée* of the engineer and the *oeuvre de raison* of the architect.[10] Critical of the artless building practice of the engineer, they called for the use of Rationalist principles in the design of iron structures. For de Baudot and the Rationalists, both the Eiffel Tower and the Galerie des Machines lacked the necessary formal and artistic quality to be considered true works of architecture.[11]

Louis-Charles Boileau -- the main spokesman of the Classicists -- acknowledged the importance of the role metal could play in the realm of construction.[12] Yet he stressed that architects had to maintain their artistic control over the material, and insisted on the necessity to hide it within the thickness of the wall.[13] He criticized the thinness of metallic structures, demanding that the expression of the load-bearing elements be visually appropriate. In accordance with academic conventions, the load-bearing elements had to appear thick. Rejecting the Rationalist "truth" as pure fallacy, Boileau argued that architectural truthfulness lay not in the real but in the "verisimilitude of forms", in the

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9 Anatole de Baudot, "L'architecture à l'exposition universelle de 1889", Encyclopédie d'Architecture, 4th ser., vol. 2, 1889-90, pp. 17-18, 25-26, 51-53.

10 Paul Gout, "Coup d'oeil rationaliste sur l'exposition universelle", Encyclopédie d'Architecture, 4th ser., vol. 2, 1889-90, p. 92.

11 See de Baudot's counter-proposal project for the Gallery of Machines in Henri Chaine, "A propos de la méthode de composition en Architecture", Encyclopédie d'Architecture, 4th ser., vol. 3, 1890-91, pp. 116-119.

12 Louis-Charles Boileau formulated his position at lenght in a series of 9 articles entitled "L'Art et le Fer", L'Architecture, vol. 2, 1889, pp. 110-115, 171-173, 181-183, 207-211, 242-244, 256-257, 373-377, 496-501, 517-523.

13 On the aesthetic of iron, Boileau wrote: "1. Le fer industriel n'obéit pas au sentiment artistique; 2. pour lui donner apparence présentable, on aboutit le plus souvent à une construction absurde, d'où 3. nécessité de l'envelopper, dans beaucoup de cas, d'un revêtements capables de recevoir l'impression artistique". Boileau, "Réponse à M. Gout", L'Architecture, vol. 2, 1889, no. 51, p. 608.

vraisemblable.[14] Accordingly, he relegated the various iron structures of the 1889 Exhibition to the category of industrial architecture, and strongly castigated the use of exposed metal in public architecture.[15]

These two competing positions were complemented by a third, more disrupting viewpoint: that of Frantz Jourdain (1847-1935), an architect trained at the Ecole des Beaux-Arts but sensitive to the positions of the Rationalists.[16] Jourdain celebrated the technological aesthetic of the engineer which -- he claimed -- was having an impact on the design of architectural forms. He praised the transparent, lightweight, linear architecture of the new glass and iron structures which was a major departure from traditional, massive, solid masonry.[17] Rejecting academic categorizations, Jourdain did not discriminate between monumental and industrial architecture, and considered the opposition between noble and common materials to be ineffectual.[18] In line with this argument, the decoration of metallic structures was to be achieved through the artistic treatment of metal itself. In contrast with Rationalism and Classicism, Jourdain's position might best be termed architectural realism. This position was shared by many architects such as Eugène Hénard, who was in charge of the work on the Galerie des Machines.[19] It was also shared by critics and writers like Edouard Champury and Emile Zola.

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[14] Boileau (see note 12), p. 115.

[15] In 1889, Louis-Charles Boileau wrote an important series of articles on the rationalism of the Gothicists and the Classicists. Boileau, "Le rationalisme gothique et la raison classique", <u>L'Architecture</u>, vol. 2, 1889, no. 50; vol. 3, 1890, nos. 2, 6, 10. For the Rationalists' response, see Paul Gout, "Réponse à M. Boileau", <u>Encyclopédie d'Architecture</u>, 4th ser., vol. 2, 1889-90, pp. 65-67; "Le Rationalisme vis-à-vis de ce que les classiques appellent 'leur raison'", <u>Encyclopédie d'Architecture</u>, 4th ser., vol. 2, 1889-90, pp. 85-88.

[16] On Jourdain, see Meredith Clausen, <u>Frantz Jourdain and the Samaritaine</u>, Leiden, E.J. Brill, 1987.

[17] See Frantz Jourdain, "L'Architecture à l'Exposition Universelle", <u>La Construction Moderne</u>, vol. 4, 1888-89, pp. 469-70; see also Jourdain, "La décoration et le rationalisme architectural à l'Exposition Universelle", <u>Revue des Arts Décoratifs</u>, vol. 10, 1889, pp. 33-38.

[18] A distinction also rejected by Champury: "Quelle amertume pour eux, de voir le fer, ce vil métal, ce roturier, ce parvenu, s'installer à la place d'honneur jusqu'ici réservée au marbre ! Au Champs de Mars, le maire du palais a usurpé le pouvoir du souverain". Champury (see note 5), p. 50.

[19] See Eugène Hénard, "Exposition universelle de 1889. Le Palais des Machines: IX. Emploi décoratif du fer", <u>L'Architecture</u>, vol. 2, 1889, no. 33, pp. 387-394.

The arguments spelled out by de Baudot, Boileau, and Jourdain are representative of conceptions about the use of iron in French architectural culture in the late nineteenth century.[20] The debate over iron developed amidst concerns for the growing role of the engineer in the realm of architecture, and the perspectives offered by the teaching of the Ecole des Beaux-Arts. Despite their divergent viewpoints, all were agreed that architectural forms could not emerge from the work of the engineer alone, that the search for architectural expression was to remain the domain of the architect. Yet their concern for architectural expression was to focus on the treatment of the structural material. Going beyond purely technical considerations of iron construction, the crux of the dispute revolved around the question of exposed metal. The use of iron in architecture prompted the Rationalists to relate the logic of the structure to the exposure of the material, drawing the equation between reason and the visible. At the height of the 1889 Exhibition, the question of modern materials in French architecture was primarily an issue of external visibility.

This dominant concern to equate truth with visibility of the structural material was largely indebted to the theoretical work of Viollet-le-Duc. In his Dictionnaire raisonné de l'architecture (1854-68), Viollet-le-Duc expounded his interpretation of architecture's history and principles.[21] According to his reading, structural and material considerations, as well as the demands of social and ritual use, were the determinants of form in architecture. He advocated the truthful use of materials and sought a compatibility of form

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20 In her book on late nineteenth-century republican art and ideology, Miriam Levin argues that during the 1870s and 1880s, artists developed strategies for civilizing technology. They developed three distinct but related attitudes about how art functioned as an agent of social and economic change: the Normative, the Inspirational, and the Deterministic approach. These approaches roughly correspond to the respective positions of Boileau (the Classical school), de Baudot (the Rationalist school), and Jourdain (the Realist trend). Miriam R. Levin, Republican Art and Ideology in Late Nineteenth-Century France, Ann Arbor (Michigan), UMI, 1986.

21 Eugène Emmanuel Viollet-le-Duc, Dictionnaire raisonné de l'architecture française du XIe au XVIe siècle, Paris, B. Bance, vol. 1-6 (1854-63); Paris, A. Morel, vol. 7-10 (1864 -68).

and ornamentation. This analytic relationship between materials, construction, and form was later to be called Structural Rationalism.[22]

In accordance with these principles, the use of new modern materials was supposed to encourage the development of a different architecture. By the mid-1850s, this ideal could be measured against a number of new architectural works making use of iron, such as Henri Labrouste's reading room of the Bibliothèque Sainte-Geneviève (1844-50) and Victor Baltard's first iron pavilion of the Halles centrales (1855-56). Yet it is the construction of the church of Saint-Eugène (1854-55) in Paris, designed by Louis-Auguste Boileau (1812-1896) that offered Viollet-le-Duc an early occasion to formulate his position. Boileau was a staunch supporter of the use of iron in architecture.[23] But his church design, which combined Gothic forms with light-weight iron construction, irritated Viollet-le-Duc and César Daly, editor of the Revue générale de l'architecture.[24] Viollet-le-Duc vividly criticized the transposition of Gothic vaults in cast iron, stating that "one should not give to cast iron the appearance of stone, for any change of materials must bring about a change of forms".[25]

Viollet-le-Duc's major reflections on iron architecture were published in his Entretiens sur l'architecture (1863-72).[26] In his prospective search for a new architecture, Viollet-le-Duc favored the use of the new materials made available by industry, such as iron and cast iron. Yet his advocacy of iron was framed by specific architectural

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22 The sources of Viollet-le-Duc's Rationalism are still a subject of debate. Two major sources are usually cited: the concern for structure in French architecture running from Perrault to Rondelet and Durand, and the scientific rationalism derived from early nineteenth-century natural sciences. Yet some studies have forcefully argued that his most direct source was the thinking and work of Henri Labrouste (see note 6).

23 Louis-Auguste Boileau, Nouvelle forme architecturale, Paris (1853); Débat sur l'application du métal à la construction, Paris (1855).

24 On the exchange between Viollet-le-Duc and Boileau, see "St-Eugène and the Gothic debate. Boileau and Viollet-le-Duc", Eugène Emmanuel Viollet-le-Duc 1814-1879, Architectural Design Profile, London, 1978, pp. 54-59. On this debate, see also Robin Middleton, David Watkin, Neoclassical and Nineteenth Century Architecture, New York, Harry N. Abrams, 1980, pp. 367-375.

25 Viollet-le-Duc, in Encyclopédie d'Architecture, vol. 5, no. 6, 1 June 1855, p. 87: "...il ne faut pas donner au fer fondu l'apparence de la pierre, c'est qu'en changeant les matériaux il faut changer les formes".

26 Eugène Emmanuel Viollet-le-Duc, Entretiens sur l'architecture, 2 vols., Bruxelles-Liège, Mardaga, 1977 (originally published in Paris by A. Morel, 1863-1872).

principles. He never really considered the metallic structures of markets and train stations as real architecture. While acknowledging the ingenuity of the Halles pavilions, he could not envision an architecture made exclusively of metal.[27] Rather, he encouraged architects to think in terms of the simultaneous use of stone and metal.[28] Yet, he also insisted that the two materials be used as separate entities to avoid problems of expansion and degradation. In such a system, metal is used under the tutelage of masonry. This tutelage is further confirmed by the fact that Viollet-le-Duc's architectural projects based on the use of metal were discussed in the *entretien* on masonry construction. His project for a vaulted hall with iron and masonry highlighted this theoretical approach.[29] In his design, Viollet-le-Duc was careful to distinguish between cast and wrought iron, assigning to each material a role in accordance with its physical properties: while cast iron was used as a support due to its rigidity and durability, wrought iron was used as tie-rods or braces, as the "nerves" of masonry construction because of its elasticity.[30] Following the organic metaphor, iron was to become the "nervous system" of masonry (fig.2).[31]

Viollet-le-Duc's position on iron architecture was notably different from the positions of the two other leading architectural theorists of the mid nineteenth century: Gottfried Semper (1803-1879) in Vienna and John Ruskin (1819-1900) in England. In his theory on the origin of architecture formulated in his major work Der Stil (1860-63), Semper placed a great emphasis on making and the transformation of materials.[32] Yet in Semper's view, matter had to serve the expression of an idea, and though he was often

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27 Viollet-le-Duc wrote: "N'y-a t-il aucun intermédiaire à trouver entre un bloc de pierre voûté, comme la Madeleine, et une gare de chemin de fer?" Viollet-le-Duc (see note 26), vol. 2, p. 47.

28 Viollet-le-Duc wrote: "Ce qu'on n'a tenté nulle part, avec intelligence, c'est l'emploi simultané du métal et de la maçonnerie. Cependant c'est vers ce but que, dans bien des circonstances, les architectes devraient diriger leurs efforts". Entretiens, (see note 26), vol. 2, p. 61.

29 Entretiens, (see note 26), vol. 2, fig. 17 & 18.

30 Bertrand Lemoine, "Viollet-le-Duc et l'architecture métallique", Viollet-le-Duc, Paris, Réunion des Musées Nationaux, 1980, p. 249.

31 On this analogy, see Jacques Gubler, "Viollet-le-Duc et l'architecture métallique: adoption du fer et tutelle de la maçonnerie", Archithèse, vol. 10, no. 4, 1980, pp. 43-47.

32 Gottfried Semper, Der Stil in den technischen und tektonischen Künsten (1860-63). For a general discussion on Semper as an art historian, architect, and theorist, see Wolfgang Herrmann (ed.), Semper und die Mitte des 19. Jahrhunderts, Basel-Stuttgart, 1974.

taken to be a materialist, recent writers have clearly shown that "his main concerns were problems of meaning and interpretation".[33] As such, his concern for new materials was to be focused on their meaning, not their structural properties. Uneasy about metallic architecture, Semper claimed that "metal would always be antimonumental and result in an invisible architecture [*unsichtbare Architektur*]".[34]

John Ruskin also expressed concerns for the role of modern materials in architecture. In the "Lamp of Truth" published in The Seven Lamps of Architecture (1849), Ruskin identifies the three types of deceit - Structural, Surface, and Operative deceits - found in the "art of architecture". For Ruskin, the use and working of materials was at the root of these architectural deceits. In the course of his argumentation about Structural deceits, Ruskin is brought to discuss the use of iron in architecture. Arguing that the art of architecture is based on the "sense of proportions and the laws of structure" developed from the use of clay, stone, or wood, Ruskin is driven to condemn the use of iron as being deceitful, and to write that "true architecture does not admit iron as a constructive material".[35] Both Semper and Ruskin were concerned by the tectonic and decorative expression of materials. For both, materials were a fundamental source of architectural meaning, and in both theoretical frameworks iron was deemed to have no potential in the production of meaningful architecture.

Contrary to Semper and Ruskin, Viollet-le-Duc believed in the potential of iron. But the use of iron raised the difficult question of the material's external expression. The exposure of iron was justified by the need to prevent the degradation of the structure. It was also based on the conviction that the current disguise of the structural material had brought moral degeneration to the architecture of his time. For Viollet-le-Duc, architectural design was to be based on logic and reason. Yet he also argued that "the

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33 Michael Podro, The Critical Historians of Art, New Haven - London, Yale Univ. Press, 1982, p. 47.
34 J. Duncan Berry, "From Historicism to Architectural Realism", Otto Wagner: Reflections on the Raiement of Modernity, ed. by H. F. Mallgrave, Santa Monica, The Getty Center, 1993, p. 256.
35 John Ruskin, The Seven Lamps of Architecture, London, 1849 (reprint New York, The Noonday Press, 1961, p. 44.

main quality that any architectural member should possess is that of appearing to fulfill the function for which it is intended".[36] The work of the architect was to "make appear", to "give appearance". Since iron members performed a specific structural task, the logic of Viollet-le-Duc's "visible argument" entailed that these elements had to be isolated and made visible.[37] As such, Viollet-le-Duc was an advocate of visual truthfulness, yet not of exposed iron. If his Rationalist discourse was no doubt influential in the advocacy of exposed iron in architecture, this was an inintended consequence of his architectural theory.

The major impetus for the use of exposed iron came from developments in Parisian architecture. Indeed, it is probably the experience of the 1878 Universal Exhibition and the development of a new building type -- the Parisian department store -- that was to induce major changes in the perception of exposed iron in architecture. With the Pavillon de la Ville de Paris by Joseph Bouvard, the Pavillon du Gaz by Stéphen Sauvestre, and the Pavillon du Ministère des Travaux Publics by Fernand de Dartein, the 1878 Exhibition offered a variety of examples of *construction apparente*, in which the metal framework was clearly distinguished from the brick infill walls (fig.3).[38] The exhibition coincided with the revision of Paris building regulations in 1878, which allowed the construction of exterior walls of less than 50 centimeters thick. This new regulation was to encourage the design of load-bearing exposed metal structures.[39] Exposed iron structures were used for the extension of the Grands Magasins du Bon Marché (1878) by Louis-Charles Boileau in collaboration with the Etablissements Eiffel, and for the new Magasins du Printemps (1881-85) by Paul Sédille.[40] The Printemps department store had a central atrium twenty

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36 Dictionnaire, vol. 7 (see note 21), p. 439: "...la qualité principale que doit posséder tout membre d'architecture, est de paraître remplir la fonction à laquelle il est destiné".

37 The expression "visible argument" is borrowed from John Summerson, "Viollet-le-Duc and the Rational Point of View", Heavenly Mansions, New York, W.W. Norton, 1963, p. 149.

38 See Frances H. Steiner, French Iron Architecture, Ann Arbor (Michigan), UMI, 1984.

39 Steiner (see note 38), pp. 101, 109, 111.

40 In an 1885 lecture, Sédille stressed that "apparent construction should only be a means and not the end." Paul Sédille, "Du rôle de la construction dans l'architecture", Encyclopédie d'architecture, 3rd ser., vol. 4, 1885, pp. 73-74.

meters high surrounded by an autonomous structure seven stories high made of exposed wrought-iron columns painted blue-grey.[41] During the 1880s, architects would design commercial buildings with metal structures independent from masonry walls, where the self-supporting iron columns were exposed to the eye. It is those structures of exposed metal that were enthusiastically described by Emile Zola in his novel Au Bonheur des Dames.[42]

The development of iron architecture received much attention during the years leading to the 1889 Exhibition. One of the main protagonists was Louis-Auguste Boileau who contributed a number of publications in an attempt to prove that iron was the "generative principle of invention in architecture".[43] In Le Fer, Boileau described the four basic types of architectural form that could be derived from iron construction.[44] Later, reflecting on the architecture of the 1889 Exhibition, Boileau was to reiterate his belief in the role of iron: "From the nature of this material, of its properties, of its aptitudes particular forms or new combinations of forms already known must inevitably emerge, which will profoundly modify the plastic appearance of architecture".[45]

Boileau's treatises focused on the genesis of new architectural forms. Yet one of the key question raised by the 1889 Exhibition was the decoration appropriate to the bare iron structure. The nature of the material demanded that the exposed iron surfaces be painted in order to protect them from rust. It raised the question of the appropriate color to be used. At the exhibition, most of the metal framed pavilions were painted in a blue-grey color.

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[41] Steiner (see note 38), p. 62.

[42] Zola wrote: "Besides, iron reigned everywhere. The young architect had had the honesty and the courage not to disguise it under a bed of whitewash, imitating stone or wood". Emile Zola, Au Bonheur des Dames, Paris, 1883 (reprinted in Les Rougon-Macquart, vol. 3, Paris, Bibliothèque de la Pléiade, 1964, p. 626).

[43] L.-A. Boileau, Le Fer, principal élément constitutif de la nouvelle architecture, Paris (1871); Principes et exemples d'architecture ferronnière, Paris (1881); Histoire critique de l'invention en architecture, Paris (1886); Les Préludes de l'architecture du XXe siècle et l'Exposition du centenaire, Paris (1893).

[44] L.-A. Boileau, 1871 (see note 43).

[45] L.-A. Boileau, 1889 (see note 43): "De la nature de cette matière, de ses propriétés, de ses aptitudes doivent naître forcément des formes particulières ou des combinaisons nouvelles de formes déjà connues, qui viendront modifier profondément les apparences plastiques de l'architecture".

This color was approved by advocates of exposed iron on the basis that it imitated the tone of wrought iron. This choice was, however, condemned by Beaux-Arts critics. In L'évolution de l'architecture en France (1894), Raoul Rozières argued that since metal was impervious to current decorative practices, only polychromy could possibly be helpful to secure the future of iron architecture. Yet he stressed that the current practice of painting the iron light grey to recall its natural color was in contradiction with its original color -- black, slate blue, or bright tin -- which was never grey.[46]

At the time of the exhibition, exposed iron in architecture had come to be closely associated with architectural Rationalism. For Viollet-le-Duc, exposure of the structural material was a simple consequence of the search for structural "honesty" and logic. But the ensuing debate between Classicists and Rationalists placed ever greater emphasis on visual paradigm. By 1889, the visibility of the structural material had become a necessary condition of architectural realism and truth. For the Rationalists, visibility had seemingly gained precedence over reason.

At the time of the 1889 Exhibition, exposed iron was already the subject of technical criticisms. In response to the plea of a Rationalist architect calling for the use of undisguised metal, the editor of a well known construction magazine underlined the weaknesses of exposed iron.[47] Making reference to recent American, German, and British experiments in covering iron members so as to increase their fire resistance, the editor asked whether this practice would not put an end to the use of exposed metal. Since the mid-nineteenth century, the defense of iron architecture had been fought on the ground of its external visibility. On the eve of the 1889 Exhibition, an observer already hinted at the possible visual eclipse of iron in architecture.[48]

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[46] Raoul Rozières, L'évolution de l'architecture en France, Paris, Ernest Leroux, 1894, p. 276.

[47] Responding to the arguments set forth by the architect J. Hermant (fils), the editor E. Rivoalen published a series of articles entitled "Le Rationalisme en architecture", La Semaine des Constructeurs, 2nd ser., vol. 1 (1886-87), pp. 530, 553-555, 578-579, 591-592; vol. 2, (1887-88), pp. 28-32.

[48] Rivoalen wrote: "Qui sait si le fer, ossature artificielle des édifices modernes les plus somptueux, ne disparaîtra pas sous l'enveloppe d'un béton quelconque connu ou à connaître: pierre artificielle aussi, qu'un revêtement plus riche, stuc, marbre, etc., viendrait recouvrir?". Rivoalen, 1887-88 (see note 47), p. 32.

2. A New Building System

The 1889 Exhibition celebrated the triumph of iron in architecture. But the doctrinal hegemony of iron construction was not to remain undisturbed. In 1889, the building scene was already altered by the emergence of a new construction system combining the use of iron with cement. And by the early 1890s, builders like Paul Cottancin, François Hennebique, and Edmond Coignet were actively promoting their newly patented construction systems. These systems were all combinations of an iron armature buried in a mixture of cement and aggregates.

The practice of covering an armature of iron with cement was not totally new. During the 1880s, German and American builders had developed methods to cover loadbearing metal structures with a sheathing of cement in order to protect them from oxidation and increase their fire resistance. These methods were most common in the United States, where the development of the multistory iron-framed building depended on the achievement of fireproofing. These practices were not unknown to French builders. But differences in its conventional building types and traditions meant that fireproof iron construction did not receive the same attention in France as in the United States.

In fact, most of the new systems developed in France during the 1890s were based on a different conception of the combination of iron with cement. While American systems focused on the distinction between the loadbearing metal structures and the cement sheath, the French stressed the exploitation of properties, by attempting to develop a system in which iron was used for its elasticity and resistance to tension, while cement was used for its resistance to compression. This combination demanded that the physical and mechanical properties of the two basic components be taken into account. Disturbing the conventional apprehension of these two artificial materials, this ingenious combination of iron and cement was received with great interest by the community of engineers and builders.

The first institutional discussions of the new experimental system took place in February 1889 at the first Congrès des Procédés de Construction, which was devoted to the study of metal and cement. At the meeting presided over by Gustave Eiffel (1832-1923), the engineer Paul Cottancin presented the result of his experimentation with "works in cement over a metal armature" (fig.4).[49] This presentation set the stage for a discussion on the properties at work in this unusual combination. According to Cottancin, iron and cement had a similar degree of expansion, a determining factor in the viability of the conglomerate. But the adhesion between the two materials was deemed to be negligible, compelling the design of a metallic armature to increase the cohesion of the work. During this meeting, Eiffel keenly acknowledged that this process -- the immersion of an iron armature in a mixture of cement -- was an advance in metallic construction.[50] Cottancin's patent for his new building system was registered in March 1889. It bore the title "Procédé de fabrication d'ossatures métalliques sans attache et à réseau continu", making a clear statement regarding the central role played by the metal armature.[51] These early experiments with the new building system are telling indications of the importance of metal construction as the privileged model of reference.

These early discussions on the combined use of iron and cement were echoed in the pages of the Encyclopédie d'Architecture, a stronghold of the Rationalist school.[52] Rivoalen situated the development of the new building method within the context of French experimentations: the works of François Coignet on *béton aggloméré* and Joseph Monier on the many applications of *ciment et fer*. From the outset, the author was eager to

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[49] Paul Cottancin, "Travaux en ciment avec ossatures métalliques", Procès verbaux des séances de la Société des Ingénieurs Civils de France, Paris, 15 February 1889, p. 90.

[50] Procès verbaux (see note 49), p. 93.

[51] For a description of the patent, see Cyrille Simonnet, "Matériau et architecture. Le béton armé: origine, invention, esthétique", doctoral dissertation, Paris, EHESS, January 1994, pp. 167, 189, 422.

[52] E. Rivoalen, "Causeries technologiques: fers et bétons", Encyclopédie d'Architecture, 4th ser., vol. 1 (1888-89), pp. 182-184, 189-190.

claim that France preceded other countries in the combined use of iron and cement. Most revealing is his discussion of the Monier system, in which iron bars were used to strengthen structural shapes made out of cement. For Rivoalen, the iron reinforcements were the structure's "bones" and "tendons", which gave strength but also elasticity to the "flesh" and "muscles" provided by the plastic concrete.[53] An analogy that is indicative of the lasting impact of Viollet-le-Duc's organicist reading of materials.

The early 1890s saw the rapid development of experiments and patents related to the combined use of iron and cement. In August 1892, the builder François Hennebique filed a patent for a system "combining metal and cement for the crafting of light and highly resistant beams" (fig.5).[54] The new invention was defended as being cheaper and more durable than metal girders.[55] Primarily conceived for the construction of floors, this beam system was also promoted for its fireproof quality.[56] The same year, the engineer and entrepreneur Edmond Coignet filed a patent for a "new construction system with straight or curved girders and lintels combining masonry and iron".[57] The originality of Coignet's system resided in the shape of the beam, composed of a lintel and a stem imitating the form of the metal T-beam.

The promotion of this new technology took different forms. While some inventors would promote the system itself, proposing different arrangements for the metallic armature, others concentrated on the objects or the works resulting from such

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[53] Rivoalen wrote: "C'étaient, pour ainsi dire, des os et des tendons venant, à la fois, renforcer et rendre élastique la matière pilonée - chair et muscles fournis par le béton plastique". Rivoalen (see note 52), p. 183.

[54] "No. 223546 - 2 juin 1892 - *Combinaison particulière du métal et du ciment en vue de la création de poutraisons très légères et de haute résistance* - F. Hennebique". In Simonnet (see note 51), p. 423.

[55] Hennebique wrote: "La présente invention a pour objet la fabrication de poutres présentant sur les poutrelles métalliques en usage des avantages extraordinaires en ce que, à poids beaucoup moindre elles sont d'une résistance beaucoup plus grande et, en outre, d'un prix de revient considérablement inférieur". Quoted in Simonnet (see note 51), p. 445.

[56] The first commercial leaflet published by Hennebique was titled "*Plus d'incendies désastreux*". See also E. Rivoalen, "Planchers à l'épreuve du feu: acier et béton de ciment", Nouvelles Annales de la Construction, 4th ser., vol. 10, September 1893, pp. 138-143.

[57] "No. 226634 - 24 décembre 1892 - *Nouveau système de construction avec poutrelles droites ou courbes et plate-bandes en maçonnerie et fer combinés* - E. Coignet". In Simonnet (see note 51), p. 424.

combination, such as flower pots, tanks, silos, or building elements.[58] These many developments received further attention from the engineering community. In 1894, the engineers Napoléon de Tedesco and Edmond Coignet presented a paper on "the calculation of works in cement with metallic armatures" before the Société des Ingénieurs Civils de France.[59] The ensuing discussion revolved around the physical behavior of the combined materials. Despite diverging interpretations regarding the adhesion between iron and cement, the meeting was effective in establishing a common ground for the scientific assessment of the properties of the new system.

Between 1893 and 1895 Paul Planat, the editor of La Construction Moderne, published a series of articles on the theory of "reinforced cement".[60] For Planat, the recent experiments of French builders were in continuity with American, British, and German developments. Thanks to the physical properties of the new system, he argued, reinforced cement construction would eventually compete with iron construction. Planat's articles were instrumental in the adoption of *ciment armé* as a generic term by which to describe the new building system, which to that point had been identified according to the configuration of the metal armature. Most such systems took the names of their inventor and/or promoter, such as the Cottancin, Hennebique, Meley, and Monier systems. This variety accurately reflected the commercial dynamic surrounding the new method (fig.6). Despite, or rather because of the existence of many systems, builders and engineers had to establish a common ground for the qualification of the system. By the mid-1890s, the new system came to be known by the generic term *ciment armé* (reinforced cement). This denomination was soon to be challenged by the term *béton armé* (reinforced concrete) however, a term forged by François Hennebique and largely known through the diffusion

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58 Simonnet (see note 51), p. 192.

59 Edmond Coignet, Napoléon de Tedesco, "Du calcul des ouvrages en ciment avec ossature métallique", Bulletin de la Société des Ingénieurs Civils de France, Paris, 16 March 1894, pp. 282-363; Discussion on the communication, 16 March 1894, pp. 225-229; Response from M. Cottancin, April 1894, p. 394; Further discussion, April 1894, p. 396.

60 Paul Planat, "La théorie des ciments armés", La Construction Moderne, vol. 9, 1893-94; vol. 10, 1894-95.

of the firm's journal Le Béton Armé.[61] Though *béton armé* gradually became the common denominator of the system, the term *ciment armé* remained in wide use until the late 1920s.

The new system and the architectural profession

The architectural profession was quick to respond to these new developments, and took great interest in the possibilities offered by the new building technique. This interest is attested by the series of articles published in construction and architectural periodicals between 1893 and 1895. Indeed, by 1895 the two main protagonists of the debate on iron architecture, Anatole de Baudot and Louis-Charles Boileau, had shifted their attention and were now reflecting on the nature and potential of *ciment armé*.

In February 1893, de Baudot gave a lecture on "the application in modern architecture of new systems and building methods, and particularly on the use of cement and iron".[62] The conference was held before the newly established Union Syndicale des Architectes Français, an association aiming at the mutual re-education of architects.[63] De Baudot described the curious properties obtained from the union of iron and cement, creating such an intimate bond as to become a special material. But while those properties were characteristic of the new technique in general, they were nonetheless embodied in specific patented systems. The system advocated by de Baudot was the one developed by the engineer Paul Cottancin. After a brief explanation of the basic structural principle of the Cottancin system, de Baudot turned to an exploration of its constructive and artistic

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61 According to Collins, discussions on the new material in England were made more difficult by the many terms in use, which included: armed concrete, armored concrete, reinforced concrete, ferro-concrete, hooped concrete, sidero-concrete, steel concrete, concrete-steel, concrete-metal. The term reinforced concrete was finally adopted in 1898. Peter Collins, Concrete: The Vision of a New Architecture, London, Faber & Faber, 1959, p. 77.

62 Anatole de Baudot, "Conférence de M. de Baudot sur L'application à l'architecture moderne de nouveaux systèmes et procédés de construction, particulièrement sur l'emploi du ciment et du fer pour la structure des planchers et des combles", Bulletin de l'Union Syndicale des Architectes Français, vol. 2, no. 2, February 1893, pp. 31-37.

63 On the Union Syndicale des Architectes Français, see Françoise Boudon, "Recherche sur la pensée et l'oeuvre d'Anatole de Baudot, 1834-1915", AMC, no. 28, March 1973, pp. 16-17.

potential. His understanding of the new building system was not solely theoretical. His description of the system's possibilities derived from his experience with the construction of his private house in Paris in 1892.[64] Yet de Baudot did not merely apply the system. At the technical level, he proposed to extend the use of the Cottancin system from the construction of floors to the construction of the roof as well. More importantly, he used the reinforced beams like *ribs* whose pattern was to be expressed on ceilings, transforming the technique into architectural tectonics.

In 1894, de Baudot further experimented with the system in the construction of the Lycée Victor-Hugo (1894-96) in Paris.[65] The school, built entirely with the new system, presented the opportunity to develop a decorative system, based on the use of colored ceramic tiles, in which the constructive and decorative processes were intimately connected. The competitions related to the forthcoming Universal Exhibition of 1900 offered de Baudot an ideal occasion to pursue his exploration of the technical, formal, and decorative possibilities of reinforced cement. In 1895, de Baudot proposed a project for the main pavilions of the 1900 Exhibition.[66] Conceived to show the architectural potential offered by the use of reinforced cement, this project placed an immense polygonal hall at the center of exhibitions galleries organized in symmetrical aisles. The main hall was surmounted by a dome based on a curious system of reinforced cement beams (fig.7).[67] The concentric configuration of the hall as well as the transition from the arched walls to the dome's supports was reminiscent of Viollet-le-Duc's studies of Slavic-Asiatic architecture published in L'Art Russe.[68] The design of the hall also recalled the forms

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[64] The house was reviewed in Paul Planat, "Une maison moderne", La Construction Moderne, vol. 9, 1893-94, pp. 289 ff, 304 ff, 316 ff.

[65] Anatole de Baudot, "Visite du Lycée Victor-Hugo", Bulletin de l'Union Syndicale des Architectes Français, vol. 2, no. 19, July 1894, pp. 318-325. The lycée was also reviewed in La Construction Moderne, vol. 11, 1895-96, pp. 329 ff, 343 ff.

[66] [Anonymous], "Conférence de M. Paul Gout sur le concours ouvert entre les architectes français pour l'exposition universelle de 1900", Bulletin de l'Union Syndicale des Architectes Français, vol. 3, no. 1, January 1895, pp. 5-17.

[67] For a thorough discussion of the project, see Françoise Boudon (see note 63), pp. 57-59.

[68] Eugène Emmanuel Viollet-le-Duc, L'Art russe: ses origines, ses éléments contitutifs, son apogée, son avenir, Paris, 1877.

developed in the theoretical projects of Louis-Auguste Boileau, especially his metallic churches.[69] For many years, Boileau had attempted to define the architectural forms that could derive from the dynamic use of iron. Inspired by the structure of Gothic churches, he had been influential in the actualization of the Gothic model through the use of iron. Though clearly indebted to the Gothic model, de Baudot's project also testifies to the search for new tectonic expressions through the use of reinforced cement elements and reveals his indebtedness to the projective shapes of iron architecture.[70]

In 1895, the engineer Paul Cottancin was invited to present his "works in reinforced cement with a metal armature" before the members of the Union Syndicale.[71] From the outset, Cottancin stressed that he was not a student of de Baudot, yet added that he belonged to his school of thought. After a brief overview on the sources of the new technique -- highlighted by a comparison with American systems of fireproof iron construction -- Cottancin argued that his system was the only one which gave birth to a truly "new material" (*matériau nouveau*). Cottancin wrote: "This mode of construction provides the long-lasting values of masonry construction with a lightness comparable to that of metallic works and gives the architect as well as the engineer the possibility to produce an artistic work by means of the adaptability and harmony of its forms."[72] Cottancin's lecture highlighted the connection between the architect and the specialized builder, an association that proved to be central for the assimilation of the new technique

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[69] See Françoise Boudon, (see note 63), p. 59. For a thorough analysis of Boileau's projects, see Bruno Foucart, "La *cathédrale synthétique* de Louis-Auguste Boileau", Revue de l'Art, no. 3, 1969, pp. 49-66.

[70] Discussing de Baudot's new approach, the engineer Georges Sorel wrote: "Jadis, Viollet-le-Duc avait proposé d'imiter en fer et maçonnerie les voûtes anglaises; l'exécution de ses projets devient très facile avec le ciment armé". G. Sorel, "Industrie. Evolution moderne de l'architecture", Revue Scientifique, 4th ser., vol. 3, 1895, no. 21, pp. 641-645.

[71] [Anonymous], "Conférence de M. Cottancin sur les travaux en ciment armé avec ossature métallique", Bulletin de l'Union Syndicale des Architectes Français, vol. 3, nos. 8/9, August-September 1895, pp. 169-225.

[72] Bulletin (see note 71), p. 176: "Ce mode de construction réalise les conditions de la durée de la maçonnerie avec une légèreté comparable à celle des ouvrages métalliques et donne à l'architecte comme à l'ingénieur la possibilité de produire une oeuvre artistique par la souplesse et l'harmonie de ses formes".

within the architectural domain. It was also to be instrumental in generating competing interpretations of the "new material" itself.

De Baudot's precocious response to the new possibilities offered by the combination of iron and cement was matched by Louis-Charles Boileau, editor of L'Architecture and secretary of the Société Centrale des Architectes. In 1895, Boileau published a series of articles on the new methods for the application of reinforced cement.[73] While acknowledging the early experiment conducted by de Baudot and Cottancin, Boileau remained unconvinced by the system's vague empirical foundation.[74] He proposed instead to turn to the study of a system which -- he claimed -- offered greater mathematical certainty, that developed by François Hennebique. The discussion of the system's potential was based on detailed evidence, both mathematical and experimental, marshalled to illustrate the qualities of the Hennebique system. Qualitative evaluation was based on a comparison with metal construction. For Boileau, the choice lay between a construction with an exposed iron framework and a construction where the iron was not exposed: the Hennebique system.[75] The practicality of the new system for architecture was further highlighted by a cost comparison between metal and reinforced cement in the construction of a typical Parisian building. According to Boileau, the estimated figures tended to prove that a structure in reinforced cement was more economical. Yet he was also careful to point out that both costs and performances remained relative to building heights and spans.

Boileau concluded by raising the question of the use and aesthetic potential of the new system in architecture. According to him, the use of reinforced cement did not have to be limited to utilitarian purposes. Following the example of iron construction, the new system allowed the invention of new discreet, unassuming forms. But more importantly,

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[73] Louis-Charles Boileau, "Le ciment armé: nouvelles méthodes d'application", L'Architecture, vol. 8, nos. 44, 45, 46, 47, 49, November-December 1895.
[74] Cottancin's empiricism was equally criticized by the engineer Napoléon de Tedesco. See Le Ciment, vol. 1, no. 6, 25 November 1896, p. 179.
[75] Boileau (see note 73), no. 44, p. 370.

the decoration of reinforced cement was deemed to be easier than the decoration of iron because it was a material which presented itself in "masses and surfaces".[76] Boileau's articles are revealing of the interpretive framework which structured his perception of the new system. At the technical level, Boileau understood the important difference between reinforced cement and iron frame construction. Yet in his comparison between the two building system, Boileau did not hesitate to make use of the distinction between exposed and non-exposed iron, framing the discussion in terms reminiscent of the recent debate on iron architecture.

Iron versus reinforced cement: devising new categories

The rapid development of reinforced cement was to challenge architects' understanding of building materials. It was also to disturb established architectural doctrines and discourses, fostering a revision of theoretical viewpoints on the nature and future of iron in architecture. Evidence of this new thinking is revealed in a series of interviews conducted by François de Villenoisy with some of the leading architects of the time. Published in 1896, the three articles titled "L'architecture en fer et l'Ecole française contemporaine" presented an overview of the state of iron architecture.[77] Published in the pages of the Revue des Arts Décoratifs, this report addressed an audience sensitive to the growing appeal of Art Nouveau.[78] Setting the stage of the debate, de Villenoisy made reference to critiques of the use of metal in architecture formulated by Charles Garnier (1825-1898). For Garnier, the architect of the Paris Opera, metal was only a means and could not become a principle, stressing that it was incapable of fostering by itself an

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[76] Boileau wrote: "Il y aurait évidemment, dans ce cas, des formes à trouver, discrètes si l'on veut, en tout cas aussi faciles à inventer que celles du fer et plus susceptibles de produire un peu d'effet, puisque nous avons affaire ici à une matière qui se présente en masses et en surfaces". Boileau (see note 73), no. 48, p. 403.

[77] François de Villenoisy, "L'architecture en fer et l'Ecole française contemporaine", Revue des Arts Décoratifs, vol. 16, 1895-96, pp. 7-15, 277-286, 325-333.

[78] From 1880 to 1902, the Revue des Arts Décoratifs informed the public and the artists about the movements and works that gave form to Art Nouveau. See Y. Brunhammer, "Viollet-le-Duc et l'Art Nouveau: influence d'une méthode", Viollet-le-Duc, Paris, Réunion des Musées Nationaux, 1980, p. 375.

artistic revolution.[79] From the outset, the tone of the report gave the veiled impression that all was not well in the world of iron architecture.

In spite of its title, Villenoisy's series of articles were not only about iron architecture. The report offered a platform for a discussion on the potential impact of reinforced cement in the future of iron architecture. The reported evaluations of the newly perfected building system differed greatly depending on the doctrinal leaning of the architect interviewed. Edouard Corroyer (1835-1904) believed that the future belonged to iron, and that its typical forms had not yet been found. Yet he was uncertain about its future since in the new development of reinforced cement iron was masked by concrete. Paul Sédille (1836-1900), architect of the Printemps department store, appeared to be even more skeptical of iron's future. Since the use of concrete was based on moulding, Sédille argued that the resulting forms obliterated all elements expressive of junctures and assemblages. They presented broad surfaces demanding a very different mode of decoration. Ferdinand Dutert (1845-1906), architect of the Galerie des Machines and a major proponent of iron architecture, perceived reinforced cement as a very useful process. Yet he also believed that its use had to be limited, and viewed the new system as a regression from an architecture using bare iron since "any process which hides the source of its strength is deemed anti-artistic".[80] Dutert argued that: "to make walls with such an anti-decorative substance as concrete, and then to hide it behind mosaics would result in a double violation of the rules of art because the material of construction would be concealed, taking us back to Byzantine decoration."[81] For many of the architects interviewed, reinforced cement was conceived as a technical development which had the immediate result of masking the iron framework. Thanks to the lasting impact of the debate on the visibility -- or concealment -- of structural materials, the aesthetic

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[79] Charles Garnier, "Le style actuel", A travers les arts, Paris, 1869, pp. 75-76.

[80] De Villenoisy (see note 77), p. 15.

[81] De Villenoisy (see note 77), p. 15: "A faire des murs avec une substance aussi anti-décorative que le béton pour ensuite la dissimuler sous des mosaïques, on violerait doublement les règles de l'art, car la substance constructive serait masquée et on retournerait à la décoration byzantine".

assessment of the new building system proved to be closely indebted to the model offered by iron construction.

In his interviews, De Villenoisy paid special attention to the position of Anatole de Baudot.[82] De Baudot also expressed doubts about the potential of iron as the "constructive element" of the future. His current praise of reinforced cement stood in sharp contrast with his previous advocacy of metal as the primary and visible material of architecture. How did he justify his position? At the technical level, iron was subject to expansion, creating a problem of liaison with other materials. But more importantly, iron could only serve as an element of support, and needed the supplement of other building materials, stone or brick, to create a wall. The use of reinforced cement overcame these problems. But the new system had to be used in a judicious way, respecting the physical properties of the various materials: reinforced cement had to be exploited for its elasticity and its resistance to tension, while supporting walls were to be made of reinforced brick. According to de Baudot, the new system -- which was viewed as an improvement upon iron construction -- held great potential for the development of a new architecture.

De Baudot's critical turn regarding metal construction was not without consequence. For de Villenoisy, de Baudot's critique of exposed metal was aligned with that formulated by Paul Henri Nénot (1853-1934), an architect faithful to the teaching of Garnier and the Academic tradition. Despite their doctrinal antagonism, both de Baudot and Nénot appeared to reject the use of exposed metal in architecture for similar reasons. That rejection de Villenoisy did not hesitate to relate to Garnier's claim that since the wall was the primary constituent of architecture, metal could not fulfil this basic need without the use of auxiliary materials -- stone or brick -- to fill in the interstices.[83]

82 De Villenoisy (see note 77), pp. 279 ff.

83 De Villenoisy wrote: "Ainsi que l'avait dit M. Garnier, le *plein* et le *mur* sont les données impérieuses de l'architecture, et le fer n'y satisfait pas sans le secours de matières auxiliaires, pierre ou brique, qui viennent en combler les interstices; or, pour opérer leur liaison avec le fer apparent, on se heurte à d'insurmontables difficultés". De Villenoisy (see note 77), p. 279.

This conception of reinforced cement in terms of the critique of metal construction appeared to be widely shared by other architects. For the architect Edouard Bérard (1843-1912), a structure in reinforced cement was conceived as an "improved" iron structure. Recalling his early studies of the system, he used the expression "revested iron" to describe the system that came to be called reinforced cement.[84] Bérard explained:

> Iron should not be used apart from its rational function, which is to say that it will therefore be limited to play its own proper role as a support, an armature, in a word: as a skeleton. The new mode of construction called *reinforced cement* appears excellent to fulfil this double goal of the use of iron and of its preservation, and at the same time to provide the masses, and consequently the surfaces able to be decorated by themselves, or by means of revetments.[85]

In light of the position developed by de Baudot and many other architects, de Villenoisy attempted to conceptualize the nature of reinforced cement. He suggested that "although invisible, iron plays the role of a *deus ex machina* in this new mode of construction".[86] Iron was conceived as the supernatural character, hidden but everpresent, giving artificial life to the new system. De Villenoisy proposed an interpretive model which divided the use of metal into two categories: *métal apparent* and *métal non visible*.[87] According to this model, the system in which metal was not visible would naturally become the domain of reinforced cement. On this framework, reinforced cement was subsumed in the category of metal construction. By placing reinforced cement

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[84] Bérard declared: "Depuis 1890... je me suis occupé de l'emploi du fer revêtu, noyé dans le ciment, ce que l'on appelle maintenant ciment armé". [Anonymous], "Congrès des Architectes Français de 1896", L'Architecture, no. 21, 23 May 1896, p. 178.

[85] [Anonymous], "Congrès des Architectes Français", L'Architecture, no. 43, 24 October 1896, pp. 321-322: "Le fer ne doit plus être employé en dehors de sa fonction rationnelle, c'est-à-dire qu'il sera désormais réduit à jouer le rôle tout spécial auquel il est merveilleusement propre, de support, d'armature, en un mot: d'ossature. Le nouveau mode de construction dit en *ciment armé* paraît excellent pour atteindre ce double but de l'utilisation du fer et de sa préservation, en même temps qu'il fournit les masses et, par conséquent, des surfaces susceptibles d'êtres décorées, soit par elles-mêmes, soit au moyen de revêtements."

[86] "Voilà un mode de construction où le fer, bien qu'invisible, joue tout à fait le rôle de *deus ex machina*, car sans lui il ne serait pas possible". De Villenoisy (see note 77), p. 280.

[87] De Villenoisy argued that the french term *métal apparent* was more accurate than the term *métal visible*, since metal could be exposed without being bare, as was the case when metal was painted. De Villenoisy (see note 77), p. 325.

in the category of "invisible" metal, this interpretation attests to the persistent influence of the Rationalist visual paradigm.

Concluding his investigation, de Villenoisy explored the aesthetic potential of the new system. He suggested that reinforced cement was better than exposed metal for the reproduction of past models, especially the Roman style, as well as vaults and cupolas. But he also believed that reinforced cement was only a useful means to address specific cases and solve difficult building problems, and could hardly be the starting point of a proper style. For deVillenoisy, the decoration of exposed-metal construction was to be primarily based on the use of metal itself. In contrast, the adoption of reinforced-cement construction, with its continuous surfaces and hollow walls, foretold the development of a very different mode of decoration.[88] It called for the use of polychromy applied to surfaces without relief, a renewed practice of mosaics where enameled bricks with vegetal or geometric motifs would be substituted for the saintly figures of Byzantine basilicas. He associated the lightness of iron architecture with the Gothic spirit, while the bare atectonic surfaces of reinforced cement were deemed comparable to Roman art. Associating the new building system with past forms, Villenoisy underscored his skepticism regarding the potential of reinforced cement to renew the formal vocabulary of architecture.

Villenoisy's interviews with some of the leading architects of the time were revealing of the uncertainty regarding the future of iron architecture. This growing uneasiness towards iron was echoed within literary and artistic circles. During the 1870s and 1880s, the realist writer Emile Zola became an enthusiastic supporter of iron architecture. In Le Ventre de Paris, Zola's protagonist Claude Lantier pits the Halles centrales market against the church of Saint-Eustache, saying: "This will kill that, iron

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[88] De Villenoisy wrote: "Le succès actuel et l'adoption définitive possible de constructions à surfaces continues et à parois creuses, établies d'après le principe du ciment armé, font prévoir une décoration tout autre". De Villenoisy (see note 77), p. 331.

will kill stone".[89] Paraphrasing Victor Hugo's famous assertion "*Ceci tuera cela*", Zola was eager to put forth his vision of social and architectural progress.[90] This belief was emphatically expressed in his description of the new department stores in his novel Au Bonheur des Dames.[91] In L'Oeuvre, Zola's main character would talk of "the solid elegance of metal girders", seeing in railroad stations and market halls the source for a new architecture of democracy.[92] But by the mid-1890s, Zola had already revised his position. Responding to a survey about modern architecture, he revealed skepticism: "Some years ago, I believed absolutely that a new material, iron, would create the basis for a new and modern style. Now it seems that we shall have to wait a long time for such a style".[93] According to Debora Silverman, Zola's skepticism was related to his feelings about the modern world, that "Modern society is racked without end by a nervous irritability. We are sick and tired of progress, industry and science".[94]

If Zola's position was a reflection of his changing attitude towards modern society and science, other commentators were more directly concerned with aesthetic issues. In 1881, the critic Joris-Karl Huysmans could write that Garnier's rejection of metal was wrong and that the task was rather to find -- following Viollet-le-Duc's ideas -- the monumental forms that derived from the properties of iron.[95] Summing up the situation shortly after the 1889 Exhibition, Huysmans was to amend his previous optimism. He despised the metallic trellises of the Eiffel Tower, claiming that iron had only been

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89 Zola wrote: "C'est une curieuse rencontre, dit-il, que ce bout d'église encadré dans cette avenue de fonte; ceci tuera cela, le fer tuera la pierre et les temps sont proches". Emile Zola, Le Ventre de Paris, Paris, 1874 (reprinted in Les Rougon-Macquart, vol. 3, Paris, Bibliothèque de la Pléiade, 1964,.pp. 338-339).

90 For thorough and compelling discussion of Hugo's vision of architecture's future in the nineteenth century, see Neil Levine, "The Book and the Building: Hugo's Theory of Architecture and Labrouste's Bibliothèque Ste-Geneviève", The Beaux-Arts and Nineteenth-century French Architecture, ed. by R. Middleton, Cambridge, MIT Press, 1982, pp. 138-173

91 Zola (see note 42), pp. 611-612, 626.

92 Emile Zola, L'Oeuvre, Paris, 1888.

93 Zola, quoted in Frantz Jourdain, "Que pensez vous de l'architecture moderne?", L'Architecture, vol. 8, no. 47, 23 November 1895, p. 393-394 (English translation in Silverman [see note 2], p. 7).

94 Zola, quoted in Silverman (see note 2), p. 7.

95 J.-K. Huysmans, "Le salon officiel de 1881", L'Art Moderne, Paris, 1883 (reprint, L'Art Moderne/Certains, Paris, Union Générale d'Editions, 1975, p. 201).

successful in the creation of interior spaces, such as in the Bibliothèque Nationale and the Galerie des Machines, failing in the design of exteriors, of facades. For Huysmans, iron still awaited the genius capable of creating unified works of architecture.[96]

Zola's skepticism was met by artists of diverse affiliation. Eugène Grasset, a decorative artist greatly indebted to the works of Viollet-le-Duc, directly addressed the aesthetic issue of the new architecture.[97] Grasset castigated the tendency to express the building's structure, arguing that natural constructions were always "covered by a skin, a bark, a shell".[98] He despised exposed iron structures made up of bolts and crossbars, calling them skinny, poor, and ugly. Most interesting in Grasset's review of architecture was his belief that the one possible future for iron would be to hide it within a plastic material that could be shaped in all possible forms. Such a construction technique would determine a style of building made possible only by iron acting as a skeleton.[99] By the mid-1890s, reinforced cement remained subsumed under the general category of metal construction. Yet the critique of iron architecture appeared to be irremediably associated with the development of reinforced cement construction. For a number of architects and critics iron architecture appeared to develop a new life within the thick membranes of reinforced cement construction.

3. From Building System to Architectural Material

In the course of the nineteenth century, the practice of architecture had been increasingly confronted with the practice of the engineer. Since the mid-1850s, the construction of

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96 Huysmans, "Le fer", Certains, Paris, 1890, (reprint, see note 95, p. 350).

97 Eugène Grasset was the author of La plante et ses applications ornementales, Paris, Lévy, 1896.

98 Grasset, quoted in Frantz Jourdain, "Petite enquête sur l'architecture moderne", L'Architecture, vol. 8, no. 46, 16 November 1895, p. 386.

99 Grasset wrote: "On finira peut-être par trouver le moyen d'employer le fer en le dissimulant dans une matière plastique pouvant recevoir toutes les formes possibles, et déterminant le style par des édifices d'une légèreté d'aspect impossible à obtenir autrement et due au soutien, à l'os intérieur". Eugène Grasset, (see note 98), p. 386.

new urban structures like large exhibition halls and train stations had provided a fertile terrain for the collaboration between architect and engineer. The major works of metallic architecture at the Universal Exhibitions of 1878 and 1889 are a case in point. The striking realization of the Galerie des Machines, achieved through the collaboration of the architect Dutert and the engineer Contamin, gave a clear example of the potential of such association. This productive alliance was not limited to Rationalist and Realist architects. The extension of the Grands Magasins du Bon Marché (1878), designed by Louis-Charles Boileau, was realized in collaboration with the firm of Gustave Eiffel.

Despite its apparent success, this association between architects and engineers was often perceived as a threat to the architectural profession.[100] While many Beaux-Arts architects rejected these productions as mere industrial architecture, unworthy of architectural status, their Rationalist counterparts called for the integration of constructional knowledge within the realm of architecture. According to Peter Collins, metallic construction established a disciplinary separation between structural design and execution. "At the end of the nineteenth-century, " Collins writes, "the introduction of steel construction suddenly divorced the technique of structural design from the realities of structural execution, as engineers calculated the size of members by formula, and entrusted the work to a new class of operatives, for whom questions of final appearance were irrelevant".[101] Engineers and building firms specializing in metallic construction were all using the same basic elements: a variety of I, L, T, and U iron sections. The use of these pre-defined elements was perceived by most architects, including the Rationalists, as a limitation placed on their design freedom.

The emergence of reinforced cement triggered the development of a new kind of collaboration: the working association between architects and specialized builders promoting their own patented system. With iron construction, the engineer could work

[100] On this question, see H. Lipstadt, H. Mendelsohn, "Architectes et ingénieurs dans la presse: polémique, débat, conflit", Paris, CORDA / IERAU, 1980.
[101] Collins (see note 1), p. 94.

independently from the building firm hired for the construction of the work. With reinforced concrete construction, the choice of a patented building system implied the adoption of a specialized builder. The specialized builder would usually combine the functions of the engineer and of the entrepreneur, being responsible for both the calculation and the execution of the work.

As we have already noted, by the mid 1890s, the architect Louis-Charles Boileau had turned his attention to the study of the Hennebique system. Boileau's apparent choice of a preferred system was matched by François Hennebique's commercial strategy. Shortly after obtaining a patent in 1892, Hennebique founded a firm to commercialize his system of reinforced concrete construction.[102] From the outset, the commercial strategy of that firm aimed at the construction industry, seeking the recognition of entrepreneurs, engineers, and architects. The firm was not, however, organized like a traditional building enterprise. Maintaining total control over the technology, Hennebique organized his enterprise as a technical office (*bureau d'études*) responsible for the calculation of the works, while the execution of the works was carried out by independent entrepreneurs, concessionaires of the Hennebique system. As such, Hennebique was not a builder himself. Yet he retained total control over the structural design and played a key role in the supervision of the execution.

Boileau's interest in the Hennebique system did not remain solely theoretical. In 1896, Boileau invited one of the most important concessionaires of the Hennebique firm to present the new building methods to his colleagues assembled at the Congrès des Architectes Français.[103] The same year, Boileau began working in association with Hennebique for the construction of the stables and storehouse of the Bon Marché department store, completed in 1897. All the structure of posts, beams, and floors were in

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[102] For a brief overview of the firm's history, see Jacques Gubler, "Prolegomeni a Hennebique", Casabella, no. 485, November 1982, pp. 40-47.
[103] Gwenaël Delhumeau, "Hennebique and Building in Reinforced Concrete around 1900", Rassegna, no. 49, 1992, p. 18.

reinforced concrete, creating an independent skeleton that was calculated so as to allow for the addition of further storeys.[104] The collaboration between Boileau and Hennebique was pursued in the design of a *galerie-terrasse* for the Paris 1900 Exhibition (fig.8). This pavilion was to serve as a showcase to demonstrate the architectural possibilities of the Hennebique system. [105] Conceived as a succession of stepped terraces, the project exploited various applications of the system: posts and beams, long span floors, cantilevers. Boileau wanted to find a decorative expression appropriate to the new material. He also wanted to make the new system formally understandable. To do so, he chose to highlight the shape of the metal reinforcement that gave strength to the concrete beams. Some of the beams were designed to express the disposition of the system's characteristic elements: bent bars, and stirrups.[106] The shape of the reinforcement was further underlined by a decorative motif painted on the surface of the beams. In this project, Boileau was wholly preoccupied by the expression of the metallic "soul" of the new material. Concealed by the concrete sheathing, the iron framework reappeared from behind the scene, an architectural version of the Freudian "return of the repressed".

Other architects were also involved with Hennebique. In 1896, the architect Edouard Bérard chose the Hennebique firm to study his project for a church to be built at Montmartre.[107] The drawings executed by Hennebique's *bureau d'études* offer a very early example of the adaptation of an architectural project to the new technique of reinforced concrete construction. This professional collaboration was pursued in a project

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[104] Boileau wrote: "... ciment partout, ciment toujours. Pas un morceau de pierre n'est entré dans la construction". Gustave Olive, "Ecuries et manutentions des magasins du Bon Marché à Paris", L'Architecture, vol. 11, no. 16, 16 April 1898, p. 139.
[105] First mentionned in Le Béton Armé in 1899, the project was only published in 1906. It was then used by Boileau in support of his polemic against the Rationalists. See Le Béton Armé , vol. 2, no. 10, March 1899, p. 13; L.-C. Boileau, "Un projet de terrasse en ciment armé", L'Architecture , vol. 19, no. 2, 13 January 1906, pp. 12-14.
[106] Delhumeau (see note 103), p. 19.
[107] Delhumeau (see note 103), p. 18.

for a triumphal bridge in reinforced concrete.[108] Working with influential architects, Hennebique sought both to familiarize practitioners with the possibilities of his system and to gain the profession's approval.

The association between architects and builders implied productive collaboration as well as mutual dependance. Publishing an exchange of letters between the rival entrepreneurs Hennebique and Cottancin, Boileau wrote: "The architects cannot but benefit from these exchanges of explanations provided that, to be precise, the latter are presented as little as possible as mere advertisements".[109] He was also conscious of the possible divergence of interest between architects and builders. While calling for a relation of "mutual support" between experts, workers, and artists, Boileau constantly asserted the position of the architect with respect to the builder.[110] Boileau's concern for the architect's position within this new working association was revealing of the challenge posed to the architectural profession by the new technique. With iron construction, structural design was carried out by the engineer, a process that had deprived the architect of technical control over the project. But with reinforced concrete --Boileau believed -- the design of the structure had to remain under the supervision of the architect. He believed that architects had to retain control over the design process and the execution, to retain control over the system itself. In fact, Boileau was later to express his hope that in the future architects would be able to invent new systems and do without both patented systems and specialized builders.[111]

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108 According to Delhumeau, it was apparently Hennebique who entrusted Bérard with the task of cladding the bridge's reinforced concrete structure that had been studied and calculated by the engineer. Delhumeau (see note 103), p. 18.

109 L.-C. Boileau, "Les travaux en ciment armé", L'Architecture, vol. 9, no. 40, 3 October 1896, pp. 299-300: "Les architectes ne peuvent que gagner à ces échanges d'explications, étant donné, bien entendu, qu'elles prendront le moins possible l'allure de simples réclames".

110 [Anonymous], "Troisième congrès du Béton de Ciment Armé", Le Béton Armé, vol. 2, no. 9, February 1899, p. 8.

111 L.-C. Boileau, "Le ciment armé et l'art de l'architecture", L'Architecture, vol. 18, no. 51, 23 December 1905, p. 473.

While collaboration between Boileau and Hennebique left the technical control of the system in the hands of the specialized builder, that between the builder Paul Cottancin and the architect Anatole de Baudot, which dated back to the early 1890s, expressed a different type of working relationship, and a different understanding. The uniqueness of this association was highlighted in the construction of the St-Jean-de-Montmartre church designed by de Baudot with the use of the Cottancin system. The construction of the church was a long process. Initiated as early as 1894, the project was finally completed in 1904 after a long delay caused by intricate legal affairs and the replacement of the original builder. Initially, after an architectural competition, the project was entrusted to Edouard Bérard, a diocesan architect who had studied under Viollet-le-Duc and had since taken an interest in the possibilities of reinforced concrete (fig.9).[112] But for reasons yet to be investigated, the project was finally assigned to Anatole de Baudot who naturally opted for the Cottancin system. Construction, which most probably started in 1897, was interrupted in 1899 due to a request by the town council for a report on the strength of the work in progress. The experts were alarmed by the flimsy-looking stabilizing elements of the building. Yet they were unable to verify the strength of the works since Cottancin refused to disclosed his mode of calculation.

At the time the church was conceived, the use of reinforced cement was still dominated by the empirical calculations of builders. Later, at the turn of the century, the builders' pragmatic knowledge was increasingly challenged by growing scientific concerns for theoretical formulations and exact figures. Yet it is empiricism that motivated de Baudot's choice of the Cottancin system, convinced that reason and logic were better design tools than science and calculation. After much legal dispute, construction of the church resumed in 1902. But only after the exclusion of the builder Cottancin and his replacement by his collaborator Gustave Degaine, who completed the work in 1904. By

[112] Marie-Jeanne Dumont,"The Philosophers' Stone: Anatole de Baudot and the French Rationalists", Rassegna, no. 49, 1992, p. 38.

that time, Cottancin's system was increasingly associated with the name of the architect, an apparent usurpation angrily contested by Cottancin himself.[113] In this instance, the architect had been successful in maintaining an overall control over both the design process and the execution. Yet this control relied on a very idiosyncratic construal of the system's technical nature.

Between the metallic and the lithic

The most important step towards the official recognition of reinforced cement was taken with the 1900 Universal Exhibition. The fair became a testing ground for experimentation with the many systems available. It was used for the confection of building parts or elements such as foundations, floors, staircases, and overhanging terraces. It was also used for the construction of entire pavilions, like the Château d'Eau built with the Coignet system, the pavilion of the St-Marin Republic built with the Cottancin system, and the Palais des Lettres built with the Hennebique system. An entire chapter of the Exhibition's official report was devoted to the analysis of results regarding the use of reinforced cement.[114] According to Alfred Picard, the official Commissioner:

> In 1900, reinforced cement constituted such an important innovation in the art of building that the organizers of the Universal Exhibition felt compelled to make a broad use of it. Its capacity to take the most diverse forms was an advantage greatly appreciated by architects. From another point of view, it could be partially substituted for steel, reducing proportionally the current problems of supplies.[115]

The prizes awarded to the firms of Hennebique and Coignet further contributed to the official recognition of reinforced cement as a suitable system of construction.

By the turn of the century, the commercial field of reinforced cement had witnessed the proliferation of patented building systems. Most systems were based on a similar

[113] P. Cottancin, "A propos de L'Eglise St-Jean-de Montmartre", La Construction Pratique, no. 25, 1 August 1905, pp. 52-53.
[114] "Généralités sur l'emploi du ciment armé dans les constructions de l'exposition", vol. 1, ch. 7 in Alfred Picard, Exposition Universelle Internationale de 1900 à Paris: Rapport général administratif et technique, Paris, Imprimerie nationale, 1902, pp. 336 ff.
[115] Picard (see note 114), p. 336.

understanding of the relationship between metal and cement, with the differences located in the modes of assemblage of the metallic armature. Yet some systems were based on a very different understanding of the combination of materials and their physical properties. The Matrai system, also called *Fer-Béton*, gives some indication of the existing discrepancies between the various systems. First patented in 1893, the Matrai system found its commercial form with a second patent entitled "Suspended constructions with metallic armatures", filed in 1895.[116] Matrai argued that the problems inherent in the preparation of the concrete on the building site forbade reliance on the strength of concrete.[117] He proposed use of a metallic framework capable of supporting loads without relying on the capacities of the plastic material -- the concrete -- in which the iron was concealed. Matrai could confidently write in Le Fer-Béton, his commercial journal: "the system *Fer-Béton* makes use of the same materials as reinforced concrete, but in a totally different way. One must not forget that *Fer-Béton* is a metallic construction designed in such a way that though the conglomerate material acts upon the system in various ways, it has no direct bearing upon its strength" [118] Matrai's formulation betrays a persistent uncertainty regarding the mechanical function of the cement within the system.[119] In 1900, Matrai received two major commissions for the Universal Exhibition: the substructures of the Globe Terrestre pavilion and the footbridge of the Avenue de Suffren. The collapse of the footbridge shortly before the opening of the exhibition -- an accident that killed several people -- raised major questions regarding the technical soundness of the Matrai system.[120]

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116 "No. 24446 - 7 Février 1895 - *Constructions suspendues à armatures métalliques*- Société Matrai, Gefrerer et Grossmann". In Simonnet (see note 51), p. 425.

117 Simonnet (see note 51), pp. 233-235.

118 Matrai, Le Fer-Béton, no. 1, 1899, p. 2: "Ainsi donc le Fer-Béton emploi les mêmes matériaux que le béton armé, mais d'une façon absolument différente. Il ne faut pas le perdre de vue un seul instant: le Fer-Béton est une construction métallique disposée d'une façon spéciale à laquelle l'agglomérant vient apporter certaines qualités d'ordre divers, mais qui peuvent très bien n'avoir aucune corrélation avec la résistance".

119 Simonnet (see note 51), p. 234.

120 The fall of the footbridge was to precipitate the downfall of the system and the company.

While the 1900 Exhibition was influential in giving the various builders an occasion to display their systems, it also brought to the fore the technical indeterminacy of the various systems. In an effort to circumscribe this indeterminacy, public officials called for the testing of the reinforced concrete structures of the exhibition. The constructive possibilities of a system might be evaluated through its use, but only the demolition of a work would prove effective to measure its real structural capacities. A the close of the fair, many tests were conducted on the Palais du Costume, a pavilion built with the Hennebique system. These tests were supervised by the newly established Commission du ciment armé, an official body whose task was to define the formulas and norms for the use of reinforced concrete.[121] The members of the Commission were government engineers like Lorieux, Rabut, and Considère, and well-known builders like Coignet, Hennebique, and Candlot.[122] It also included Jacques Hermant (1855-1930), who represented the architectural profession. This body of experts was modeled on the Commission set up a decade earlier to devise new regulations pertaining to the use of metal structures.

By the turn of the century, engineers and builders were arguing over the need to develop the equations and norms that would give a scientific foundation to the material's pragmatic successes. Most claims regarding the need for scientific calculation were tempered by the builders' shared belief that the making of reinforced concrete on the building site was the key to achieving a sound construction. This issue was of great concern for Hennebique, who defended his pragmatic position against the theoretical leanings of Government engineers.[123] The empiricism of specialized builders stood in

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121 P. Planat, "Institution d'une commission du ciment armé", La Construction Moderne, vol. 16, 1900-1901, pp. 500-501.

122 On the work of the Commission, see G. Delhumeau, "Le béton armé et le Ministère des Travaux Publics: la circulaire de 1906", paper presented at the third meeting of the DRAST, Paris, METT, 8-9 November 1993.

123 See [Anonymous], "Science et empirisme", Le Béton Armé, vol. 5, no. 51, August 1902, p. 45; Paul Gallotti, "1892-1902. Dix ans de Béton Armé", Le Béton Armé, vol. 5, no. 55, December 1902, pp. 112-113.

sharp contrast with the vision of architectural critics. In a review of the new Hennebique headquarters completed in 1900, the critic Pascal Forthuny insisted on the scientific nature of the material. He wrote: "[Reinforced concrete] is not a *matériau de hasard* which gives approximate results. It is, amongst all materials, the one where mathematical precision is best achieved, the least disputed. It is constructed following determined laws, resulting in precise equations controlled by calculation".[124]

The task of the new Commission was to settle the technical definition of the system, divided as it was between the pragmatism of the builders and the idealism of the critics. In the preamble to the Commission's report, the definition of the new system was framed by a discussion of the inherent limitations of masonry and metallic construction. The major defect of masonry was deemed to be the joint, while the major defect of metal construction was the rivet. Moreover, the qualities of metallic construction were deemed to be diammetrically opposite to the ones of stone construction. The report concluded that reinforced concrete possessed all the advantages and none of the shortcomings of stone and metal constructions, offering a perfect synthesis of the two principal materials.[125]

From the outset, the Commission stressed that one of the main characteristic of reinforced concrete works was their monolithic quality. Based on the assemblage of rigid yet resilient elements, iron construction was conceived in terms of articulated structure and equilibrium . By contrast, reinforced concrete was in need of a term that would describe the structural dynamics of constructions with the new system. In his precocious manual on the applications of reinforced concrete, Paul Christophe argued that the new system, replacing the metallic armature until then deemed necessary, would realize true monolithic construction.[126] In the absence of a technical constant to distinguish the many systems, the notion of monolithism provided an explanation of the behavior of structures.

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[124] Pascal Forthuny, "Le ciment armé rue Danton", Le Béton Armé, vol. 3, no. 36, May 1901, p. 2.
[125] Planat, (see note 121), p. 501.
[126] Paul Christophe, Le béton armé et ses applications, Bruxelles, J. Goemaere, 1899, p. 5 (2nd edition published in Paris by Ch. Béranger, 1902).

This notion was used by the specialized firms as a key argument in the promotion of their system. Writing on the ten- year experience of the Hennebique firm, the editor of Le Béton Armé insisted on the homogeneity of reinforce concrete works, arguing that the built structure reacted as a unitary block.[127]

But the notion of monolithism was not solely grounded in the realm of technical culture. The association of the new system with the monolithic quality was made as early as 1895 in the Revue des Arts Décoratifs.[128] The notion was rooted in architectural tradition. In his analysis of Roman construction, Auguste Choisy insisted on the monolithic quality of agglomerate construction: "the body of the edifice amounts to a mass of gravel and mortar, a built monolith, a sort of artificial rock."[129] In the first volume of his Traité d'architecture published in 1898, the professor Louis Cloquet makes reference to Egyptian *pisé* construction as an example of monolithic concrete works.[130] Yet in the fifth volume published three years later, it is the new combination of concrete reinforced with iron or steel that is deemed to achieve the quality of the monolith.[131] This theoretical definition appeared central to the architects advocating the new system. For Paul Gout, a spokesman of the Rationalist school, it was precisely the monolithic quality of reinforced cement construction that was fated to transform architectural conceptions.[132]

The architectural notion of monolithism was further substantiated by changes in the description of the material itself. During the 1890s, iron construction appeared to be the major point of reference. Yet around 1900, the agglomerate material -- cement and

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127 Paul Gallotti (see note 123), p. 113.

128 Villenoisy (see note 77), p. 326.

129 Auguste Choisy, Histoire de l'architecture, vol. 1, Paris, Gauthier-Villars, 1899, p. 512: "le corps des édifices se réduit à un massif de cailloux et de mortier, un monolithe construit, une sorte de rocher artificiel". See also: L'Art de bâtir chez les Romains, Paris, 1873.

130 Louis Cloquet, Traité d'architecture (vol. 1), Paris-Liège, Béranger, 1898, pp. 10-11.

131 Louis Cloquet, Traité d'architecture (vol. 5), Paris-Liège, Béranger, 1901, p. 289.

132 Paul Gout stated: "Ne suffit-il pas d'envisager la possibilité qu'elle procure de faire des constructions monolithes, pour imaginer la perturbation qu'elle doit fatalement amener dans tous les modes de conceptions architecturales usités jusqu'ici ?". A. Gelbert, "Conférence sur l'architecture au XXe siècle et l'Art Nouveau, par M. Paul Gout, architecte", La Construction Moderne, vol. 19, no. 14, 2 January 1904, p. 159.

concrete -- came to play a more central role in the definition of the system. This emphasis was most clearly expressed in the realm of specialized publications. Inaugurated in 1896, the commercial periodical Le Ciment published regular articles on the various systems of reinforced cement.[133] In 1901, the critic Pascal Forthuny contributed articles on the history of cement and concrete to Le Béton Armé.[134] It was followed by an article on the history of Roman concrete, astutely linking modern reinforced concrete with the mythic concrete of the Roman building tradition.[135] This shift of focus was encouraged by Hennebique, who sought to establish the precedence of reinforced concrete over iron construction. Denouncing the "betrayals" of iron -- its major competitor -- Hennebique rhetorically insisted on the determinant role of cement.[136] It was but one step in a strategy that aimed at the definition of reinforced concrete as an wholly "new material".[137]

This emphasis on the precedence of cement and concrete helped sever the ties with metal construction. It had a major impact on architectural thinking. Displacing iron architecture as the model of reference, these narratives challenged architect's readings of the new building material. Shifting attention from the metal reinforcement to the concrete mass, architects and critics began to focus on the lithic quality of the new material, hinting at a new genealogy for reinforced concrete construction.

4. The Eclipse of Iron and the Mutation of Rationalism

Celebrated in 1889, iron architecture had already suffered a serious setback by the time the new century was launched. This swift change of prospect was most clearly revealed at

[133] Le Ciment, Organe officiel de la Chambre syndicale des fabricants de ciment Portland de France, edited by A. Fayolle, Paris (1896-1936).
[134] Pascal Forthuny, "Bétons et ciments historiques", Le Béton Armé, vol. 4, no. 38, July 1901, pp. 22-24; no. 41, October 1901, pp. 63-69.
[135] Forthuny, "Mortiers et bétons romains", Le Béton Armé, vol. 4, no. 43, December 1901, p. 93.
[136] See [Anonymous], "Les trahisons du fer", Le Béton Armé, vol. 4, no. 47, April 1902, p. 156; no. 48, May 1902, p. 175.
[137] [Anonymous], "Conférence de M. Flament à la Société centrale d'Architecture de Belgique", Le Béton Armé, vol. 4, no. 44, January 1902, pp. 97 ff.

the 1900 Universal Exhibition. Commenting on the architecture of the fair, most critics remarked that iron was now concealed, hidden behind the *staff* or stone facades of the many pavilions. This masking of the structures was further acknowledged in the official report on the exhibition's works: "In 1889, we had adopted a system where the metallic skeleton was left exposed.... This time, the skeleton has been entirely masked behind a revetment, a kind of architectural drapery which envelops it".[138] Yet many exhibition structures made extensive use of exposed metal. The Grand Palais offered a large display of iron works, with its large metallic roof structure and its elaborate iron staircase by Albert Louvet (fig.10). The Gare d'Orsay, designed by Victor Laloux, also made use of a large metallic roof structure. But both the Palais and the Gare reaffirmed the separation between external masonry construction and internal metallic structures common in the second half of the nineteenth century. Though iron and steel remained largely in use, the exhibition was to highlight the visual eclipse of metal.

This concealment of iron was lamented by the architects and critics of Rationalist leaning. Frantz Jourdain expressed great disappointment at the architectural masquerade of the 1900 Exhibition, viewing this reversal as an Academic regression.[139] The concealment of iron was due no doubt to the stylistic prerogatives of the Beaux-Arts architects in charge of the exhibition. Yet according to Bertrand Lemoine, it was probably a consequence of the change of attitude of the industrial bourgeoisie itself, which turned away from the conspicuous expression of progress and rationality in search of more perennial expressions of wealth.[140] This changing attitude is best translated in the

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[138] Rapports du jury international. Exposition Universelle. Paris. 1900. Groupe VI - Génie Civil, Paris (1902), p. 511: "En 1889, on s'était arrêté à un système où l'ossature métallique était laissée apparente... Cette fois, l'ossature a été entièrement masquée derrière un revêtement, sorte de tenture architecturale qui l'enveloppe..."
[139] Jourdain wrote: "A l'exposition universelle de 1889, un sincère mouvement vers la vérité s'était manifesté, et on avait héroïquement cherchee à se débarasser des oripeaux du mardi gras dont nous étions affublés.... En 1900, le faux et le toc triomphent sur toute la ligne, à de trop rares exceptions près." Frantz Jourdain, "Les conquêtes de la science - l'Architecture", L'Architecture, vol. 13, no. 42, 20 October 1900, pp. 378-379.
[140] Bertrand Lemoine, L'Architecture du fer. France: XIXe siècle, Seyssel, Champ Vallon, 1985, p. 288.

thinking of the cultural critic Melchior de Vogüé who had praised the iron architecture of the 1889 Exhibition. In 1900, he repudiated "his faith in the universal technological civilization prefigured in the Eiffel Tower", explaining that the promises of 1889 were not to be realized.[141] Rather than a "point of departure on an ever-ascending ladder", the "iron architecture of 1889 was more like the culminating point of a descending curve". For de Vogüé, iron architecture had become a useful yardstick by which to measure the changes in perception of the technological civilization. It was also a reference point in his assessment of modern materials:

> In 1889, iron bravely exhibited itself, autonomous and naked, making us sole judge of its aptitudes as an architectural element. Today, iron is envelopped in tow coated with plaster, that is *staff*; it hides behind a sheathing of mortar, that is reinforced cement.[142]

Making no distinction between load-bearing iron structures and reinforced-concrete systems, this comment is indicative of the author's lack of concern for technical matters. But more importantly, it reveals the predominance of the visual paradigm in the analysis of modern materials. With the 1900 Exhibition, the regression of iron was seen as the result of a double eclipse: masked behind stone or *staff* facades, iron was also hidden in the heart of the new building system.

Influenced by these changing cultural perceptions, many art critics saw the exhibition as a demonstration of the failure of iron architecture as a whole. Reflecting on the aesthetic of the exhibition, Robert de la Sizeranne did not hesitate to write that the rejection of iron was probably linked with a question of visual habits, and with the fact that iron was a support, not a surface.[143] Locating the source of this regression in the

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[141] De Vogüé, quoted in Silverman (see note 2), p. 315.

[142] De Vogüé, "La défunte exposition", Revue des Deux-Mondes, vol. 162, 15 November 1900, p. 393: "En 1889, le fer s'offrait bravement à nous, seul et nu; il nous faisait juges de ses aptitudes comme élément architectural. Aujourd'hui, le fer s'enveloppe d'étoupes enduites de plâtre, et c'est le staff; il se dissimule dans une chemise de mortier, et c'est le ciment armé".

[143] Robert de la Sizeranne, "L'Art à l'Exposition 1900 - L'esthétique du fer", Revue des Deux-Mondes, vol. 159, 1 May 1900, pp. 175-206.

material itself, these critiques raised serious doubts about the potential of iron to generate a new architecture.

Many critics lamented the failure of iron architecture. Yet for most architects and writers affiliated with the Beaux-Arts tradition, the fall of iron architecture was welcomed as a return to a more sensitive approach. This position was widely expressed in the pages of La Construction Moderne. Echoing the reflections of the writer Octave Mirbeau, the editor Paul Planat launched a vehement critique of iron architecture. Contrasting the dryness of iron with the plasticity of stone, Mirbeau castigated the material for its qualitative shortcomings.[144] Planat added that iron had been utterly unsuccessful in the creation of the new style: "Numerous essays have been attempted by talented artists: metal remains spindly, and the more skilfully it is treated, the more spindly it appears. It will always remain as a *carcasse*, as a skeleton, and will always be deprived of flesh and skin".[145] Planat was harshest in his critique of Rationalist tenets when it came to discussing the color of painted iron. He rejected the Rationalists' claim that the light grey color was more representative of iron's nature, encouraging instead the adoption of bright heraldic colors such as purple, silver, and gold. Planat continued his critique of iron architecture in an exchange with the writer André Halleys. For Halleys, the 1900 Exhibition was a regression in which old architecture had taken its revenge upon iron.[146] Planat's response was to be a radical rejection of any assumption regarding the revolutionary role of iron and steel.[147]

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144 Mirbeau wrote: "On avait essayé du fer, ô Eiffel ! Mais le fer est dur, sec, plat, et il ne se modèle pas, comme la pierre dont la plasticité est admirable, et sur qui le temps agit sans cesse, comme le coup de pouce d'un sculpteur immortel et génial". Quoted in Planat, "Actualités", La Construction Moderne, vol. 15, no. 28, 14 April 1900, p. 327.

145 Planat (see note 144), p. 327: "Des essais ingénieux ont été maintes fois tentés par des artistes de talent; le métal reste grêle, et plus il est habilement employé, plus grêle il paraît. Il ne fournira jamais qu'une carcasse, un squelette, auquel il manque toujours la chair et l'épiderme".

146 Halleys wrote: "Mais l'architecture, la vieille architecture, a vu avec terreur le métal devenir chaque jour plus souple et plus ductile; elle a pris sa revanche. Le mot d'ordre a été: Cacher le fer. Et partout on a disimulé les charpentes métalliques comme des choses honteuses". Quoted in Planat, "Actualités", La Construction Moderne, vol. 15, no. 35, 2 June 1900, p. 410.

147 Planat wrote: "Quant à voir dans le fer, fût-ce même dans l'acier, l'aliment qui doit nourrir l'architecture de l'avenir, que M. Halleys nous permette encore de le lui dire: Ce sont des idées surannées

The critique of the rationalist position was also echoed in the pages of L'Architecture.[148] The architect Gaston Redon (1853-1921) recognized the contribution of the Rationalist school born with Labrouste and best embodied in the architecture of exposed iron. Yet he was critical of the excesses of the "logician" school and its abusive use of iron. An architect representative of one of the trends within the Beaux-Arts school, Redon welcomed the recent change of attitude: "A reaction manifests itself at this time against the abuses of the logician school, against iron, which we now think of hiding, like the skeleton is hidden by the muscles".[149] Planat's and Redon's critiques of "rationalist logic" and iron architecture were confirmed by contemporary developments in American architecture. At the International Congress of Architects held in Paris during the 1900 Exhibition, one session was devoted to the study of construction using metallic frameworks. The session focused on recent American experiments in high-rise steel construction. The paper presented by A. D. F. Hamlin discussed the "external architecture of high-rise buildings in the United States of America".[150] Given the degradation of metal when exposed to bad weather conditions, Hamlin argued that it was imperative to sheathe the metallic framework, "to disguise it with a revetment of protective materials".[151] For American builders, the direct expression of the metallic frame was not on the agenda.

The widespread critique of exposed metallic frameworks coincided with changing attitudes regarding the employment of iron in French architecture. Going beyond the

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aujourd'hui, nées il y a longtemps, lorsqu'on connaissait peu le métal et que l'on pouvait se faire de grandes illusions sur son emploi et les ressources à en tirer". Planat (see note 146), p. 411.

[148] Frantz Jourdain et al., "Les conquêtes de la science - L'Architecture", L'Architecture, vol. 13, no. 42, 20 October 1900; no. 43, 27 Octobre 1900; no. 44, 3 November 1900; no. 47, 24 November 1900.

[149] Redon said: "L'école logicienne, née avec Labrouste, s'est emparée du fer et en a peut-être abusé; elle a cependant produit des monuments intéressants.... Une réation se manifeste en ce moment contre les abus de l'école logicienne, contre le fer, qu'on cherche maintenant à cacher, comme le squelette est caché par les muscles". In L'Architecture (see note 148), pp. 387-388.

[150] A. D. F. Hamlin, "L'Architecture extérieure des édifices hauts aux États-Unis d'Amériques", in Congrès International des Architectes (Cinquième session tenue à Paris du 29 juillet au 4 août 1900), Paris, 1906.

[151] Congrès International des Architectes (see note 150), p. 233.

discussion of iron as a structural material, many architects began to focus on its adaptation for the decoration of structures. The debate on ornament was triggered by the desire to move away from the conventional forms of industrial rolled and cast iron. In Art Nouveau in Fin-de-Siècle France, Debora Silverman highlights the shift in the use and meaning of iron between 1889 and 1900, showing that this shift can be interpreted as a passage from the monumental to the ornamental, from the public to the private realm.[152] In 1889, the decoration of metallic structures had been mostly based on the combination of standardized iron elements. In 1900, the major pavilions of the exhibition such as the Grand Palais and the Petit Palais were adorned with forged and ornamental ironwork, with decorated wrought-iron elements that often twined around the metal structures. The Pavillon de la Grèce designed by Lucien Magne also displayed a wealth of ornamented structural elements based on abstract or geometrical motifs (fig.11).

Lucien Magne was a vocal advocate for the use of iron as a decorative material in architecture.[153] In his early retrospective reading of nineteenth-century French architecture, Magne argued that modern architecture was caracterized by a decorative principle based on the rational use of materials. Magne insisted on the role played by Henri Labrouste, whom he considered the first to depart from the reprehensible practice of hiding the metal, using it as a decorative element in the reading rooms of the Bibliothèque Sainte-Geneviève and the Bibliothèque Nationale (fig.12).[154] For Magne, Labrouste's use of exposed iron generated an authentic revolution in the art of building.[155] While recognizing the increasing role played by science, he maintained that

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152 Silverman (see note 2), p. 5. I stress, however, that Silverman is concerned with Art Nouveau as an interior design style with a history separate from that of architecture.

153 Lucien Magne was a student at the Ecole des Beaux-Arts in the late 1860s and early 1870s. Trained in the atelier of his father, A.- J. Magne, he was named professor of History at the Ecole in 1891 and professor of applied arts at the Conservatoire National des Arts et Métiers in 1899. See Henri Poupée, "Magne, Lucien (1849-1916)", in Les Professeurs du Conservatoire National des Arts et Métiers, ed. by C. Fontanon and A. Grelon, vol. 1, Paris, CNAM, 1994, pp. 169-181.

154 Lucien Magne, "L'Architecture moderne", Art et Décoration, vol. 3, January-June 1898, pp. 45-53, 73-80.

155 Magne said: "L'application du fer apparent, osée par Labrouste, détermina une véritable révolution de l'art de bâtir". Magne in Jourdain et al., (see note 148), vol. 13, no. 42, 20 October 1900, p. 377.

only architects were able to design the forms appropriate to the material. Magne's interpretation laid the basis for a new genealogy of nineteenth-century architecture, and was the first retrospective reading to include the major works of iron architecture. Yet in his articles of the early 1900s, he increasingly focused on the decorative possibilities offered by the artistic manipulation of iron.[156] For Magne, the progress of iron construction seemed to find its natural resolution in the design of decorative elements, a new emphasis that epitomized the cultural shift from the structural to the ornamental.

Reinforced cement and the mutation of Rationalism

At the turn of the century, iron architecture had become a convenient target for the critique of "rationalist logic". Yet this critique unfolded at a time when the main exponent of the Rationalist doctrine had clearly moved away from the advocacy of exposed metal in architecture. In the early years of the new century, Anatole de Baudot's Trocadéro lectures had become the main platform for the doctrinal defense of reinforced-cement architecture. This advocacy of the new system took place in the context of the debate on Art Nouveau. In 1903, Paul Gout noted the failure of iron to develop a new architecture.[157] This revolution was only to come with reinforced-cement construction, conceived as an improvement upon iron construction. For Gout, the monolithic constructions resulting from the use of this new system transformed the modes of architectural conception. Emphasizing the mutation from iron to reinforced cement, the Rationalists propounded a Darwinian conception of materials and their impact on architecture.

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[156] Lucien Magne, "Le fer dans l'art moderne", Revue des Arts Décoratifs, vol. 20, 1900, pp. 351-358, 378-382; "La décoration du fer", L'Art décoratif, vol. 5, 1900, pp. 122-133; "Résumé du cours de M. Magne. Applications de l'art au travail des métaux", Revue des Arts Décoratifs, vol. 22, 1902, pp. 33-48.

[157] Gout wrote: "Le fer fondu ou laminé aurait dû, depuis quarante ans déjà, révolutionner de fond en comble l'art de bâtir, tant dans ses systèmes de structure que dans ses formes générales. Et s'il ne l'a pas fait, c'est parce que les architectes ont manqué d'une méthode générale dans leurs applications de ce procédé de construction". Paul Gout, in A. Gelbert (see note 132), p. 159.

The growing impact of reinforced cement was not limited to the French scene. These issues were debated at the International Congress of Architects held in Madrid in 1904. The secretary of the session on "The Influence of Modern Construction Processes on Artistic Forms" was the Dutch architect Hendrik Petrus Berlage, who had just completed the construction of the Amsterdam Stock Exchange in 1903.[158] It was Berlage's contention that though iron was very useful, it had not been able to fulfil its promises and there could not be such a thing as an iron style in either the present or the future. He believed that iron had been superseded by a new invention: reinforced cement. Yet the new system was viewed as a consequence of the invention of iron construction. Works in reinforced cement synthesized the advantages of both iron and stone.[159] Convinced that the new material was opening up a new architectural period, Berlage called for the study of its potential artistic form.[160] His arguments were sustained by Pieter J.H. Cuypers, the dominating figure of Dutch architecture. Cuypers argued that the development of a *style nouveau* depended on the existence of a *principe générateur*. This principle required that materials be used in accordance with their physical qualities and that the means of their implementation be honestly expressed.[161] The session adopted a resolution stating that among all new construction processes, reinforced concrete was the one which adapted most to artistic forms since it allowed the possibility to build decoratively.[162]

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158 "Theme IV: Influence des procédés de construction dans la forme artistique", Congrès International des Architectes, (Sixième session tenue à Madrid du 6 au 13 avril 1904), Madrid, 1906.

159 Berlage wrote: "La seconde grande invention constructive est, pour ainsi dire, la conséquence de l'invention de la construction en fer.... est celle du ciment armé, du système Monier, qui usant le fer enveloppé, unit par sa construction, les avantages des deux matériaux, celui du fer et celui de la pierre". Congrès International des Architectes (see note 158), p. 175.

160 Berlage wrote: "C'est pourquoi, à cause des grands avantages constructifs du ciment-armé, j'en suis venu à croire par les réflexions sus-dites, que nous sommes arrivés à une nouvelle période d'architecture, dans laquelle le ciment armé sera le matériel principal, et que l'étude de sa forme artistique est absolument nécessaire". Congrès International des Architectes (see note 158), p. 176.

161 Congrès International des Architectes (see note 158), p. 180.

162 "Parmi tous les nouveaux procédés de construction, le béton armé est celui qui prête les meilleurs services à la forme artistique, étant donné que sa façon d'être et de s'exécuter permet de construire décorativement". Congrès International des Architectes (see note 158), p. 183.

These theoretical discussions were reported in the pages of La Construction Moderne.[163] Focusing primarily on architectural aesthetics rather than technique, they confirmed the shift in professional scrutiny from iron to reinforced cement. By that time, exponents of the Classical tradition like Paul Planat and Louis-Charles Boileau had also shifted attention to the doctrinal evaluation of reinforced cement. While the central qualities of the system, such as its capacity for monolithic construction, were recognized, its potential in the production of architecture remained a major subject of debate. Reinforced cement was conceived as a potential alternative to load-bearing metal structures. Rejecting any determinism of construction over forms, reinforced cement was merely a new building system to be added to the ones already available, and based on the use of wood, stone, and iron.

Despite his thorough technical knowledge of the system, Boileau continued to insist on the fundamental heterogeneity of reinforced cement, showing that the definition of the new system remained subject to doctrinal interpretations. For Boileau, the role of iron within a reinforced-concrete element was deemed comparable to the role it played in the reinforced stone lintels of the French building tradition.[164] This technical distinction had a specific architectural meaning. Conceived as the combination rather than the synthesis of two different substances, reinforced cement was denied the status of *material* given to stone or iron. As such, it was denied the channce to embody any specific architectural style, and be expressed as an authentic building material. For Boileau, reinforced cement was at best one among the many building systems available to the architect.[165]

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163 Paul Planat, "Actualités. Le VIe Congrès International", La Construction Moderne, 16 April 1904, pp. 337-339; 30 April 1904, pp. 364-365; 11 June 1904, pp. 440-441.

164 Boileau wrote: "Pourquoi trouveraient-ils à redire à ce que d'autres se servent de pierre armée, en élevant dans l'espace avec l'aide du fer, des plates-bandes appareillées ? C'est pourtant le même jeu, puisque le métal intervient exactement de la même façon dans les deux cas, pour donner aux matières, ciment ou pierre, auxquelles on l'associe, sans le montrer, la qualité de résistance à la traction qui leur manque autant à l'une qu'à l'autre." L.-C. Boileau, "L'Art Nouveau", L'Architecture, vol. 13, no. 51, 22 December 1900, p. 466.

165 I suggest to call Boileau's approach to materials and technique "technical eclecticism". This notion is developed by Jean-Pierre Epron in "L'éclectisme technique", Les Cahiers de la recherche architecturale, no. 29, 1992, pp. 81-90.

By contrast, the Rationalists argued that the material was to foster a radical renewal of architecture. This militant support for the new composite material was best formulated in L'Architecture et le ciment armé by Anatole de Baudot.[166] The author conceived the new material as a derivative of iron, possessing all its advantages, and securely making up the deficiencies introduced by the direct use of metal. Though grounded in a technical knowledge of the material, this conception was equally motivated by doctrinal considerations. As an improvement of iron construction, reinforced cement could claim continuity with the rationalist theoretical tradition, while as a new material, it could claim a central place in the Rationalist discourse on architectural change.

De Baudot was obviously concerned with the physical and technical aspects of the new material, but these concerns were closely related to formal and aesthetic ones. In fact, the Rationalists' conception of the material was more empirical than scientific, and their architectural designs appealed to reason and logic rather to calculations. As such, the external forms of structural elements were primarily conceived on the basis of their visual appropriateness rather than on mathematical delineation.

Developing his theoretical viewpoint, de Baudot insisted on the distinction between reinforced cement and reinforced concrete. He advocated the exclusive employment of cement, rejecting the use of concrete mixes of cement and aggregates. This rejection was motivated by the necessity to maintain the thinness of structural members, considered more robust as well as more appropriate for the conception of a new architecture. De Baudot revealed thereby his indebtedness to the forms of iron structures and architecture. With the adoption of the Cottancin system of reinforced cement, de Baudot sought to maintain the distinction between the various functions of the architectonic members, between the supporting and supported elements. He sought to retain a visual expression of the laws of materials. With his defence of reinforced cement, de Baudot attempted to

[166] Anatole de Baudot, L'architecture et le ciment armé, Paris, Office général d'Editions artistiques, n.d. (c. August 1905).

preserve the legibility of the structural members, threatened as they were with disappearance beneath the thickness of concrete.

With the adoption of reinforced cement, the Rationalism advocated by Anatole de Baudot and his followers was to be notably different from that defended by Viollet-le-Duc. In an apparent reversal of Viollet-le-Duc's conception, the use of reinforced cement came to be viewed as the necessary condition for the development of a new architecture. What was initially considered as an enabling factor had become a precondition for the development of a rational architecture. By the early 1900s, the Rationalists' adoption of reinforced cement had favored the development of a dogmatic attitude that might best be called "technical determinism".

Still more importantly, the adoption of reinforced cement gave rise to a paradoxical situation. For Viollet-le-Duc, metal construction was conceived in terms of elastic structures and equilibrium, providing a key by which to read the structure of Gothic architecture. In its search for tectonic expression, the Rationalist school had gradually turned to the advocacy of the slender exposed structures of metallic architecture. Turning their attention to reinforced cement, the Rationalists attempted to salvage the slenderness and shapes of iron structural members. Yet this slender skeleton was achieved by means of a material generating monolithic structures. In fact, the monolithic quality of reinforced cement construction posed a direct challenge to the organic understanding of architectural structures. De Baudot's answer to the problem is indicative of the distance already taken from Viollet-le-Duc's organic principle. Giving precedence to visual appearance, the Rationalists favored the development of formal expressions as *representations* of dynamic structures.

The adoption of reinforced cement also challenged the Rationalist principle regarding the visibility of the structural material. With iron construction, the Rationalists called for the exposure of the structural material. But with reinforced cement, the iron armature was suddenly covered by a cement sheathing. Wasn't this technical choice in contradiction with the Rationalist principle demanding that the "structural" material be visible? Louis-Charles Boileau, the most attentive critic of the Rationalist school, was quick to make the charge.[167] Though polemical in its intent, Boileau's question was never given a proper answer. Beginning with his early experiences at the Lycée Victor Hugo, de Baudot had argued for the revival of decorative techniques and the use of ceramics. That call for the decoration of the cement surfaces points to a revision (re-reading) of the principle equating "honesty" and "truth" with the visibility of the structural material. With the concealment of metal from view, the very idea of the need to expose the structural material was to recede into the background.

This revision of Viollet-le-Duc's principles was substantiated by de Baudot's later critique of his master. According to de Baudot, Viollet-le-Duc had failed to accomplish a structural reformation. But if his failure was most notably due to his lack of examples and practical applications, it was due also to the fact that he only knew iron, "a defective building material" only usable in composite structures that entailed the risk of technological compromise.[168] With reinforced cement the problems were automatically solved. In the words of Marie-Jeanne Dumont, "reinforced cement was the philosophers' stone, the ideal building material that could have transformed the rationalist doctrine -- which had always remained on paper -- into well-built architecture".[169] For de Baudot and the Rationalist school, reinforced cement had become the privileged vehicle to achieve the triumph of reason in architecture.

Conclusion

By the early years of the new century, French architectural circles had pronounced the downfall of iron as the key material of architectural renewal. While the use of iron and

167 Boileau wrote: "Quelques-uns, des maitres incontestés, n'ont-ils pas ces temps-ci adopté le ciment armé ? Est-ce que, dans ce genre de construction, le fer ne joue pas, au point de vue de la résistance, un rôle égal à celui du ciment ? Ces messieurs le dissimulent". L.-C. Boileau (see note 164), p. 466.
168 Anatole de Baudot, L'architecture, le passé, le présent, Paris, Heni Laurens, 1916, p. 202.
169 Dumont (see note 112), p. 39.

steel increased in building construction, metal had lost the strategic place it had occupied in modern architectural theories until the last decade of the century. The reasons for this downfall were manifold. But while technical and economic issues certainly played a part, they were not central to the loss of faith in iron. The disillusionment of cultural critics with progress was echoed by architects' oft-repeated tallies of metal's many deficiencies: thinness of structural members, absence of wall surface, etc. Yet the increasing dissatisfaction with iron coincided with the emergence of reinforced concrete. It could well be argued that the downfall of iron would not have come about in the way it did had it not been for the existence of a new alternative.

Technical experimentation with the material was closely followed in architectural circles. Architects were prompt to identify the architectural problems raised by the new building systems long before they became common in building construction. With the immersion of an iron armature in a mixture of cement, the original properties of these hitherto distinct materials were suddenly overshadowed. By its very heterogeneity, reinforced concrete challenged architects' conceptions of building materials. The nature of the new building system -- or more appropriately, the uncertainty regarding the nature of the system -- was to challenge accepted categories. At first, disregarding technical distinctions between fireproof skeleton and reinforced concrete systems, architects were prompt to read the new material in the context of their own doctrinal frameworks. From the outset, the theoretical construal of the new system was to be delimited by the debate on the role, use, and expression of iron in architecture. This early confrontation between metal and reinforced concrete was to challenge the Rationalist equation between the expression of the structure and the visibility of materials. Iron construction had raised the question of architectural "truth", which was to be achieved through the visibility of the structural material. With reinforced concrete, the Rationalist equation between visibility and truth was placed in a state of permanent crisis.

CHAPTER II

THE FRAME AND THE WALL:
The changing *ethos* of reinforced-concrete architecture (1900-1914)

The period between the turn of the century and the first World War occupies a central yet ambiguous position in the history of architectural modernism. In France, this period is commonly viewed as the moment when an emerging aesthetic centred around reinforced concrete accelerated the demise of historicism. The task of interpretation is made more difficult by the fact that the development of reinforced-concrete construction was paralleled by the unfolding of Art Nouveau. For some, the rise and fall of Art Nouveau was a manifestation of the exhaustion of nineteenth-century bourgeois taste. For others, the blossoming of Art Nouveau inaugurated the demise of historicism, a preparatory stage in the development of modern architecture. For most interpreters, the rationalism of reinforced-concrete architecture clearly distinguishes it from the more exhuberant practices of Art Nouveau. In this chapter, I analyze the development of reinforced-concrete architecture in light of contemporary debates on architectural expression.

Following the theoretical demise of iron as the key material of architectural renewal, many architects turned their attention to the expressive possibilities offered by reinforced-concrete construction. Early experiments in the use of reinforced concrete in France are commonly divided by two fundamental orientations: the first is the affirmation of the continuity of the wall by concealing the reinforced-concrete framework, the second is the interest in the affirmation of the structural frame. For Françoise Choay, the latter position -- called structuralist -- was promoted by Anatole de Baudot and best interpreted by Auguste Perret.[1] In this position, "ethic and aesthetic coincide to exalt the material which has to be expressed according to the structural system conforming to its nature".[2] For

[1] See Françoise Choay: "Techniciens et architectes autour de 1900", Art de France, vol. 3, 1963, pp. 311-320.
[2] Choay (see note 1), p. 320: "Ethique et esthétique coïncident ici pour exalter le matériau qu'il s'agit de laisser apparaître selon le système structurel conforme à leur nature."

Choay as for a majority of interpreters, the expression of the concrete frame is the common denominator of the protomodernist works of de Baudot and Perret, using the structural paradigm as the privileged link among the works of the period.

Focusing on the works of Anatole de Baudot and Auguste Perret, this chapter examines Choay's interpretive assumption. The structural paradigm is analyzed in light of de Baudot's church of St-Jean-de-Montmartre (1896-1904), and Perret's apartment building on the rue Franklin (1903-04), works which were widely recognized as the embodiment of an architectural alternative to historicist practices. Shifting attention from the expression of the frame to the conception of the wall, I argue that these works embody two contrasting interpretations of tectonic and ornamentation, and that the focus on structural expression conceals more profound differences in the interpretation and implementation of reinforced concrete in architecture. These early works are contrasted with Perret's later project for the Théâtre des Champs-Elysées (1911-13). Questioning accepted interpretations of Perret's theater as the embodiment of the structural paradigm, the analysis focuses on the role of the frame in the qualification of the program and facade of the building.

Changes in the conception of reinforced-concrete construction are best expressed in the mutation of architectural ornamentation. While the decoration of early reinforced-concrete buildings is often presented as a concession to Art Nouveau taste, I shall argue that in early projects the adoption of ornamental facing was in accordance with current conceptions of the new building system. Discussing Perret's project for the Champs-Elysées theater, I examine how the abandonment of this decorative practice marks the transition from the ornamental skin to the monumental mask.

1. Reinforced concrete and architectural expression

By the early 1900s, architectural circles had turned their attention to evaluating the implications of reinforced concrete for architecture in general. This question was not totally new, for it had been raised recurrently by architects and critics during the 1890s. Yet it is around the turn of the century, with the works of the 1900 Exhibition and the establishment of the Commission du ciment armé, that the study of the new system was put on the architectural agenda. In the fifth volume of his Traité d'architecture published in 1901, Louis Cloquet -- architect, engineer, and professor -- discussed the impact of reinforced concrete on architecture.[3] Examining the capabilities offered by concrete construction -- a system still placed under the general category of metal construction -- Cloquet stated that "all current forms of structure as well as historical styles are subject to disappear".[4] Cloquet's assertion was to be central in the debate regarding the use of reinforced concrete.

The construction of Hennebique's headquarters on the rue Danton in Paris (1899-1900) presented an early case by which to test this theoretical forecast. Designed by the architect Edouard Arnaud in collaboration with Hennebique's engineering office, the building was meant to express the architectural possibilities offered by the Hennebique system. This association proved to be demanding for the architect, compelled as he was to design an appropriate and respectable facade for both the system and the firm. The difficulty of the task was acknowledged and discussed in a published exchange that followed the completion of the building, an exchange which raised some of the main issues architects would have to address in the critical use of reinforced concrete.[5] The

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[3] Louis Cloquet, "Tome V: Esthétique, composition et décoration", in Traité d'architecture, Paris-Liège, Béranger, 1901.

[4] Cloquet wrote: "Que deviendront le fer et l'acier noyés dans le béton et le ciment ? Maintenant qu'on possède le moyen de monter des maisons entières en béton et de faire des édifices monolithes avec du ciment, toutes les formes actuelles de structures sont exposées à disparaître en même temps que les formes des styles historiques". Cloquet (see note 3), p. 289.

[5] E. Arnaud, "Réponse de M. Arnaud", Le Béton Armé, vol. 3, no. 36, May 1901, p. 5.

critic Pascal Forthuny argued that since reinforced concrete was different from previous construction systems, its external expression and motifs should come from its inner properties:

> Reinforced concrete is a new material, and has no links with the systems of construction which preceded it; thus it must necessarily draw from within itself its exterior aspects, which must be clearly differentiated from familiar motifs in wood, marble, or stone. How can one introduce innovative lines and surface modelling in domestic architecture that are in some way the consequence of the use of reinforced concrete? Can one even demand of this one method of construction a suitable decorative effect ?[6]

For Forthuny, reinforced concrete was a new material. Borrowing from what was by then a widely shared Rationalist assumption, he argued that the use of a new material was fated to develop new formal and decorative expressions.

In his response to Forthuny, the architect Edouard Arnaud focussed on the definition of the material:

> I can only agree with all that you have said: any new material must have its characteristic expression. But the expression proper to reinforced concrete is unfortunately still extremely vague.... We are accustomed to the fact that each material, wether stone, wood, marble, or iron has, by its molecular constitution and its fabrication, a precise application in construction.... Concrete, for its part, may in turn replace structurally, iron, wood, or stone.[7]

For Arnaud, the problem resided in the indeterminacy regarding the definition of the material itself. While agreeing in theory with Forthuny, Arnaud stressed that since concrete had the capacity to replace iron, wood, or stone structurally, and thus lacked any characteristic expression, the search to find the appropriate architectural expression would

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[6] Pascal Forthuny, "Le ciment armé rue Danton", Le Béton Armé, vol. 3, no. 36, May 1901, p. 2: "Le ciment armé est un nouveau venu, il ne tient par aucune attache aux systèmes de construction qui le précèdèrent; il est donc nécessaire qu'il tire de lui-même des aspects extérieurs nettement différenciés des motifs qu'on rencontre dans la pierre, le marbre ou le bois. Par quel moyen innover dans l'art du décor de la maison, des lignes, des reliefs qui soient en quelque sorte la conséquence de l'utilisation du béton armé ? Peut on demander à ce mode de construction *seul* un effet décoratif convenable ?"

[7] Arnaud (see note 5), p. 3: "Tout ce que vous avez dit, je le pense et je me range absolument à votre avis: chaque matériau nouveau doit donner naissance à une expression nouvelle. Mais l'expression propre au béton armé est malheureusement bien vague encore.... Nous sommes habitués à ce que chaque matériau: pierre, bois, marbre, fer, etc., ait par le fait même de sa constitution moléculaire et de sa fabrication un emploi bien spécial dans le bâtiment.... Le béton, lui, peut prendre tour à tour, structuralement s'entend, la place du fer, du bois ou de la pierre."

prove difficult. Recalling Hennebique's comment that "there is nothing that reinforced concrete may not achieve, it can reproduce everything", Arnaud added that reinforced concrete was the result of moulding, and that all shapes could be given to the mold.[8] For the architect, the distinctive character of concrete vanished in the breadth of its applications: "Reinforced concrete is more than a material, it is a totally new construction process which permits the realization of all kinds of forms, the solution of all constructional problems ..., and can appear under all kinds of costume. It is too general to have a proper physiognomy".[9] This exchange is telling of prevailing uncertainty with regard to the natural, logical, and/or rational expression of reinforced concrete in architecture. It underlined the nature of the architectural task, divided between decorative imitation and formal invention.

These critical discussions on the new system's potential impact on architectural forms took place while the architectural scene was stimulated by the new aesthetic practices of Art Nouveau. Largely diffused through the periodicals L'Art décoratif and Art et Décoration, the artistic program of Art Nouveau was a challenge to historicist practices in architecture.[10] By contrast, works identified with the Art Nouveau trend -- also known as Modern Style -- were often the subject of suspicious reviews by L'Architecture and La Construction Moderne. For Louis-Charles Boileau and the Classicists, the designs of these architects and decorative artists were viewed as individualistic and perceived as a threat to established rules of composition and decoration. Boileau did not hesitate to equate the so-called 'frivolities' of Art Nouveau with the 'reasonable' researches of the

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8 Arnaud wrote: "C'est ce qui faisait répondre à M. Hennebique: on peut tout demander au béton armé, il peut tout reproduire." Arnaud (see note 5), p. 4.

9 Arnaud (see note 5), p. 4: "C'est que le béton armé est plus qu'un matériau proprement dit, c'est un procédé absolument nouveau de construction, permettant facilement de réaliser toutes les formes, de résoudre les problèmes de construction les plus variés..., pouvant revêtir les costumes les plus multiples, les plus bizarres, ou se contenter d'un simple revêtement en ciment. Il est trop général pour avoir une physionomie bien particulière."

10 For an analysis of these critical issues, see Nancy Troy, Modernism and the Decorative Arts in France: Art Nouveau to Le Corbusier, New Haven and London, Yale Univ. Press, 1991.

Rationalists.[11] This problematic equation was made possible thanks to the lasting influence of Viollet-le-Duc's principles. Indeed, many artists of Art Nouveau leaning like Eugène Grasset, Frantz Jourdain, or Hector Guimard, had recognized Viollet-le-Duc's works as a major source from which they derived their search for organic construction and for the expression of the nature of building materials. By the turn of the century, Viollet-le-Duc's doctrines had given birth to two distinct programs: the organicism of Art Nouveau and the structural materialism of the Rationalists.[12]

The Rationalist school resisted the assimilation with Art Nouveau practices. Anatole de Baudot vehemently rejected the Modern Style, arguing that the making of a new art, an *art nouveau*, could not be achieved without the use of new materials.[13] This causal relationship between new materials and new artistic forms was reiterated by Paul Gout, *Architecte en chef des monuments historiques* and spokesman of the Rationalist school.[14] Recalling that a new artistic attitude had been generated by the ideas of John Ruskin and the works of William Morris, Gout questioned their contribution to the genesis of a genuine *art nouveau*.[15] For Gout, the real source of a true *art nouveau* was Viollet-le-Duc, giving birth to a new art that would be very different from the current 'Modern Style' developed by the English and adopted by the French. Calling for "reasoning in art", Gout argued that current practices were driven by the obstinate and conspicuous search of mannerist originality and the *jamais vu*. He wrote: "To be genuine, newness in

[11] Boileau wrote: "Rationalistes sérieux, imaginatifs raisonnant plus ou moins leurs conceptions, ou chercheurs d'architecture de rêve,....voilà les artistes de l'Art Nouveau". L.-C. Boileau, "Causeries", L'Architecture, vol. 13, no. 48, 1 December 1900, p. 431.

[12] See François Loyer, "De Viollet-le-Duc à Tony Garnier: la passion du rationalisme", L'Architecture de l'Art Nouveau, ed. by Frank Russell, Paris, Berger-Levrault, 1982, pp. 103-135.

[13] Gelbert stated: "Si M. de Baudot fut impitoyable pour le *modern style*, par contre il s'est montré plein de sollicitude pour le ciment armé, si en vogue depuis quelques temps. On ne peut, a-t-il déclaré, faire de l'art nouveau sans employer à cet effet de matériaux nouveaux". A. Gelbert, "Cours du Trocadéro. Conférence de M. de Baudot", La Construction Moderne, vol. 19, no. 10, 5 December 1903, pp. 111-113.

[14] A. Gelbert, "Conférence sur l'architecture au XXe siècle et l'Art Nouveau, par M. Paul Gout, architecte", La Construction Moderne, vol. 19, 19 December 1903, pp. 136-138; 26 December 1903, pp. 148-149; vol. 20, 2 January 1904, pp. 158-159.

[15] Beginning in 1895, Robert de la Sizeranne published a number of articles on the thinking of John Ruskin in the journal Revue des Deux-Mondes: "La religion de la beauté - Etudes sur John Ruskin. Sa physionomie", 1 December 1895; "Ses paroles", 1 June 1896; "Sa pensée", 1 February 1897; "Sa pensée sur l'art", 1 March 1897; "Sa pensée sur la vie", 15 April 1897.

art should not be intentional: it should be occasional. One does not invent an *art nouveau*; it grows naturally from circumstances external to the will of the artist".[16] For Gout and the Rationalists, one of those external circumstances resided in the physical properties of the new construction system: reinforced cement. The monolithic constructions resulting from reinforced cement were fated to transform the modes of architectural conception.[17] For the Rationalists, reinforced cement was the key material that could help carry an *art nouveau* further, radically transforming current modes of conception. Yet the exact nature of this transformation and its impact on architectural expression remained a major subject of debate.

The architectural expression of reinforced concrete was one of the issues debated at the International Congress of Architects held in Madrid in 1904.[18] The debate took place during the session on "The Influence of Modern Construction Processes on Artistic Forms", a session attended by, among others, Hendrik Petrus Berlage and Pieter J.H. Cuypers from Amsterdam and Maurice Jalvo and Henri Fort from Madrid.[19] By the turn of the century, Berlage had become a leading figure of European architecture, a practitioner and theoretician whose thinking was partly indebted to the writings of Viollet-le-Duc. After a discussion on the respective qualities of modern industrial materials, Berlage argued that architects "had arrived at a new period of architecture where reinforced concrete would be the main material", and that this new mode of construction could be the starting point of a future style.[20] Yet for Berlage, the artistic results so far obtained with the new mode of construction were nonexistent, partly because its specific

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[16] Gout, quoted in Gelbert (see note 14), pp. 148-149: "Pour être vraie, la nouveauté en matière d'art ne doit pas être *intentionnelle*: elle doit être *occasionnelle*. On n'invente pas un art nouveau; il naît naturellement de circonstances étrangères à la volonté de artistes."

[17] Gout stated: "Ne suffit-il pas d'envisager la possibilité qu'elle procure de faire des constructions monolithes, pour imaginer la perturbation qu'elle doit fatalement amener dans tous les modes de conceptions architecturale susités jusqu'ici ?". Gout, quoted in Gelbert (see note 14), p. 159.

[18] Congrès International des Architectes, (Sixième session tenue à Madrid du 6 au 13 avril 1904), Madrid, 1906.

[19] "Theme IV: Influence des procédés modernes de construction dans la forme artistique", in Congrès International (see note 18), pp. 174-198.

[20] Congrès International (see note 18), p. 176: "...nous sommes arrivés à une nouvelle période d'architecture, dans laquelle le ciment armé sera le matériel principal."

building characteristics were still misunderstood and partly because it did not have the patina of stone, brick, or wood. He concluded that "the study of its artistic form was absolutely necessary."[21]

Berlage's position was contested by the Spanish architect Henri Fort. Fort stressed that if "expressive beauty" could be found in architectonic construction, it was only when the form expressed the nature and condition of the material that it could truly be called artistic. Yet the very qualities of concrete and reinforced concrete made it impossible, he believed, to develop forms revealing their nature. Quoting a study by his compatriot Maurice Jalvo, Fort affirmed that "reinforced concrete does not impose any predetermined forms and accepts the ones created by the artist and specified by the builder", adding "that a material which does not have a distinctive physiognomy does not possess its own means of expression."[22] Fort concluded that "the modern construction processes [concrete and reinforced concrete] which replace the combination of constructional elements by monolithic molded products, are not able to express the artistic form corresponding to an architectonic work."[23]

The exchange between Berlage and Fort highlighted the question of the material's indeterminacy. Cuypers could well argue that "to give birth to a new style, one must have a *principe générateur* which is that the use of the material must be set according to its qualities and must always reveal its mode of construction."[24] Puig y Cadalfach could well argue for the dependence of artistic form on construction. Many participants still believed that the fundamental nature of the material could not be defined, undermining all attempts

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[21] Congrès International (see note 18), p. 176: "l'étude de sa forme artistique est absolument nécessaire."

[22] Congrès International (see note 18), p. 189: "Mr. Jalvo... n'hésite pas à affirmer que le béton armé n'impose aucune forme déterminée et qu'il accepte celle que crée l'artiste et donne le constructeur." Fort added: "...un matériau qui n'a, pour ainsi dire, aucune physionomie propre, ne peut non plus posséder des moyens d'expression."

[23] Congrès International (see note 18), p. 190: "Les procédés modernes qui remplacent la combinaison d'éléments constructifs par des produits monolithiques moulés, ne peuvent exprimer la forme artistique qui correspond à l'oeuvre architectonique."

[24] Congrès International (see note 18), p. 180: "Pour enfanter un style nouveau, il faut avoir un principe générateur, qui est que l'emploi de la matière doit se faire en raison de ses qualités et en laissant toujours apparaître les moyens mis en oeuvre."

to achieve a new artistic form. The problem did not seem to lie primarily in the opposition between architectural doctrines, but rather in the definition of the material and its making process. Despite these contradictory viewpoints, the Congress nonetheless adopted the proposition that "among all new construction processes, reinforced concrete was the one which adapted most to artistic forms since it provided the possibility to build decoratively."[25] The development of artistic forms would derive from two interrelated levels of practice: the architectonic and the ornamental. With reinforced concrete, architects possessed a material that permitted the development of an architecture as 'decorated construction'. The task which lay ahead was to find, or create, its most appropriate architectural forms.

2. The Skeleton and the Skin

With the completion in 1904 of the apartment building situated on the rue Franklin in Passy, the young architects Auguste and Gustave Perret presented a challenging response to the problem of the architectural expression of reinforced concrete. The 25bis rue Franklin -- as the building has come to be identified -- has been at the center of most discussions of the precursors of architectural modernism in France. Recent studies have explored the multifaceted aspects of the building, revealing the richness and complexity of Perret's early achievement.[26] These studies have convincingly shown that the modernity of the building did not rest solely on the expression of the reinforced-concrete frame. However, the 25bis rue Franklin is still in need of a further assessment in light of the broader culture of reinforced-concrete construction at the turn of the century.

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[25] Congrès International (see note 18), p. 183: "Parmi tous les nouveaux procédés de construction, le béton armé est celui qui prête les meilleurs services à la forme artistique, étant donné que sa façon d'être et de s'exécuter permet de construire décorativement."

[26] See especially the thematic issue of Rassegna on Auguste Perret: "Perret: 25bis rue Franklin", no. 28, December 1986.

Due to the absence of contemporary comments by the architect, the interpretation of the 25bis rue Franklin has been problematical. Auguste Perret's first formulations of his architectural doctrine appeared on the eve of the first World War. Moreover, explanations based on possible theoretical sources -- starting with Viollet-le-Duc -- present many shortcomings, for they tend to set aside the specific problems brought about by the use of the new material. In the following section, the use of reinforced concrete is discussed in light of one of the main contemporary building tasks: the design of the modern wall. Shifting attention from the expression of the frame to the conception of the wall, I argue that 25bis rue Franklin embodies a new understanding of the tectonic and ornamentation of reinforced-concrete construction.

The modern wall

By the turn of the century, reinforced concrete was increasingly used as an alternative material in the making of specific building elements, such as floors and staircases. It could also be used in the making of entire building structures, offering a potential alternative to stone and iron construction. Such an alternative posed a direct challenge to the technical and architectural conception of buildings. More specifically, it had a major impact on the conception of the building wall.

Edouard Arnaud's design for the Hennebique headquarters in rue Danton in Paris highlighted the key problem that architects faced with the use of reinforced-concrete construction (fig.13). The design was meant to express the architectural possibilities offered by the Hennebique building system. In a review of the building, the editor of Le Béton Armé insisted on the contrast between the appearance of stone dressing and the lightness of the entire facade: "M. Arnaud, the architect, has preserved the general motifs of stone construction, though they were much thinned down, so that one is disconcerted by this lightness which gives the impression of iron construction".[27]

[27] [Anonymous], "Maison de Rapport rue Danton à Paris", Le Béton Armé, vol. 3, no. 36, May 1901, p. 1: "M. Arnaud, l'architecte, y a conservé les motifs généraux de la construction en pierre, motifs cependant

Arnaud's decision to give to the concrete wall the appearance of stone construction has been recurrently faulted on the ground that his treatment of concrete was based on the imitation of another material. For most reviewers, Arnaud's design choice points to the question of imitation as the central problem of reinforced-concrete construction. Yet one of the major problems faced by architects using the new building system was the conception of the wall itself. With reinforced-concrete construction, a key element of architectural composition stood on the brink of an architectural revolution, the nature of which Arnaud was already contending. On the rue Danton building, Arnaud imitated stone construction in an attempt to give a certain thickness to the light wall obtained by the use of reinforced concrete. For Arnaud, the main architectural task was to find the appropriate "representation" for the modern wall.

Problems regarding the conception and representation of the modern wall were first raised with the development of iron-frame construction. The use of a frame structure called for the employment of an infill material to complete the wall. The method commonly adopted was a combination of metal-frame structure and brick infill. Its most well-known occurrence was the Ménier chocolate factory in Noisiel on the outskirts of Paris, designed by Jules Saulnier (1828-1900) and built in 1871. This building was commended by Viollet-le-Duc in the second volume of his Entretiens sur l'architecture.[28] He further explored the possibilities of frame and infill construction with a theoretical project for an urban house published in his eightieth *entretien*.[29] For Viollet-le-Duc, the wall could be conceived as an exterior skin, an infill in glazed brick or terra-cotta. The use of these new infill materials received further attention at the 1878 Universal Exhibition with, among others, the Pavillon de la Ville de Paris by Joseph Bouvard and the Pavillon

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bien allégés, à tel point que l'on est dérouté devant cette légèreté, qui procède un peu de la construction en fer."

28 Viollet-le-Duc, Entretiens sur l'architecture, Paris, A. Morel, 1863-1872, (reprint, Bruxelles-Liège, Pierre Mardaga, 1977, vol. 2, p. 334).

29 Viollet-le-Duc (see note 28), pp. 325 ff.

du Ministère des Travaux Publics by Fernand de Dartein.[30] The use of terra-cotta and glazed bricks as building materials was also advocated by the influential architect Paul Sédille.[31] Though Sédille did not directly associate the use of these materials with metal-frame construction, he played a major role in their promotion. With the 1889 Universal Exhibition, the use of skeleton construction was extended to a multitude of pavilion buildings, including the Dôme central et Palais des Industries diverses by Joseph Bouvard (fig.14), and the Palais des Beaux-Arts et des Arts Libéraux by Jean-Camille Formigé. Reviewing the exhibition, the editor of the Encyclopédie d'Architecture wrote:

> To build using a structural skeleton and a light infill is a principle that imposes itself more each day because of our needs and our modern materials. This construction process is very old, is well-known and is used daily by architects today. But rarely have we had the courage to express it plainly.[32]

By the end of the century, the system of iron frame with glazed brick or terra-cotta was common, but generally used only for buildings of lesser prestige. In fact, one of the major criticisms raised against the use of iron in architecture was the loss of the wall surface. Emphasizing the presence of the skeleton, the use of metal had broken up the traditional material unity between the structure and the envelope, and disrupted one of the fundamental elements of French architecture: the wall. Earlier in the century, Charles Garnier had criticized the use of metal for its inability to constitute the wall, the element he considered to be both constituent of, and fundamental to, architecture.[33] This concern

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30 See Pierre Chabat, La brique et la terre cuite, Paris, A. Morel, 1881; see also: Bernard Marrey, La brique à Paris, Paris, Picard/Editions du Pavillon de l'Arsenal, 1991.

31 Paul Sédille, "La terre cuite et la terre émaillée dans la construction et la décoration", pamphlet, 1877; see also Sédille, "L'architecture contemporaine et les industries d'art qui s'y rattachent", Bulletin mensuel de la société centrale des architectes, 6th ser., vol. 2, 1885, pp. 28-33.

32 Henri Chaine, "Exposition universelle de 1889", Encyclopédie d'Architecture, 4th ser., vol. 2, 1889-1890, p. 27: "Constituer un édifice à l'aide d'une ossature résistante et d'un remplissage léger, tel est ... le principe qui nous est imposé chaque jour d'avantage par nos besoins et nos matériaux modernes. Ce procédé est ancien, connu et employé journellement par les architectes. Mais il est rare qu'on ait le courage de l'accuser franchement...".

33 Garnier wrote: "Lorsqu'il faudra clore et enserrer, lorsqu'il faudra faire le mur, le fer sera rejeté comme incompatible avec le plein, et comme le plein et le mur sont les données premières et impérieuses de l'art architectural, il faudra revenir aux matériaux qui peuvent les suivre". Charles Garnier, A Travers les Arts (1869), pp. 95-96.

was raised again at the time of the 1900 Universal Exhibition. Commenting on the fate of iron architecture, Robert de la Sizeranne underlined that iron was only a support and was unable to provide a tangible surface.[34] De la Sizeranne's critique coincided with Julien Guadet's call for the study of the wall as the primary element of architecture.[35] The development of reinforced concrete-construction presented the ideal medium to maintain the practice of skeleton construction, while reinstating the material unity between structure and envelope.

The development of systems of reinforced-concrete construction encouraged research on the modern wall and the use of new materials. Anatole de Baudot's early experiment with the Cottancin system is a case in point. Since reinforced cement permitted the constitution of a rigid floor that could be supported at a limited number of load-bearing points, de Baudot required only a thin wall, developed out of two partitions -- one in stone and one in brick -- separated by a void.[36] This hollow wall system was conceived as a natural complement to the Cottancin system. The new wall was used also in the construction of the Lycée Victor Hugo (1894-96) (fig.15). The facade walls in brick were very thin (22 cm) since the floors were carried by pillars absorbed within the party walls. By 1895, de Baudot had developed a system of reinforced bricks that, combined with reinforced cement ribs (*épines-contreforts*) and slabs, enabled the construction of a monolithic and unitary structure.[37] In such a structure, the double brick partition fulfilled all the requirements of the modern wall: thermal insulation, heating, etc.

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34 De la Sizeranne wrote: "le fer est un support, ce n'est pas une surface". Robert de la Sizeranne, "L'Art à l'Exposition 1900 - L'esthétique du fer", Revue des Deux-Mondes, vol. 159, 1 May 1900, pp. 175-206.

35 Julien Guadet, Eléments et théorie de l'architecture, vol. 1, Paris, 1901, pp. 201 ff.

36 Anatole de Baudot, "Conférence de M. de Baudot", Bulletin de l'Union Syndicale des Architectes Français, vol. 2, no. 2, February 1893, p. 35.

37 Cottancin wrote: "Avec des briques de 50 millimètres d'épaisseur en double cloison armée suffisamment avec nos épines contreforts ou seulement en simple cloison également armée d'épines, on construit des façades de maisons à six étages portant planchers pour des surcharges aussi fortes qu'on le désire". P. Cottancin, "Conférence de M. Cottancin sur les travaux en ciment avec ossature métallique", Bulletin de l'Union Syndicale des Architectes Français, vol. 3, nos. 8/9, August-September 1895, p. 223.

As these early experiments make clear, the use of reinforced-concrete in architecture was not immediately conceived as a substitute for iron-frame construction. At first, its use was limited to the construction of building parts rather than entire frameworks. Exploiting the potential of the Cottancin system, de Baudot's conception was based on both the intimate association of the various building parts (floors, walls, and roof), and the marriage of the metal armature with cement and/or bricks. Conceived in this way, the system of reinforced cement developed by Cottancin and improved by de Baudot offered the means to restore the lost 'unity of material' once achieved with stone architecture.

De Baudot's experiments were conducted at a time when most architects were only beginning to be acquainted with the new systems. The development of the building market in turn of the century Paris offered architects the opportunity to experiment with the new system in the construction of residential and office buildings. One of the most direct effects of its use in the design of modern buildings was the constitution of load-bearing structures permitting thinner walls. The use of iron elements in the construction of apartment buildings in Paris had been widespread since the middle of the century. But their use was more often limited to the construction of specific building parts like floors, or lintels for the opening of ground-floor shops.[38] In fact the use of load-bearing metal armatures for the construction of apartment buildings was most uncommon, with urban regulations encouraging traditional building methods based on the construction of facade and party walls in masonry. With the use of the newly developed reinforced-concrete systems, architects were able to design structural frames which called for a new conception of the wall, involving the integration of its three constituent parts: the structure, the infill, and the outer skin (the decorative revetment).

With the construction of the Hennebique headquarters in 1899, Arnaud and the firm's engineering office developed an innovative wall system. The structure of the building was unique. It combined a skeleton merged within a continuous reinforced wall

[38] See François Loyer, Paris XIXe: l'immeuble et la rue, Paris, Hazan, 1987.

(fig.16). All the constructional elements were in reinforced concrete, except for the party walls with neighboring buildings which were in rough stone masonry in compliance with the building code.[39] The facade wall had a uniform thickness of 18 centimeters, including the cement coating and the thickness added by the decoration. Required to define an expression appropriate for reinforced concrete, the architect attempted to express the thickness of the wall. It is this choice which triggered a discussion on the architectural expression and decoration appropriate for reinforced concrete.

The process of experimentation begun on the rue Danton was pursued with the conception and construction of François Hennebique's family residence (1901-03) at Bourg-la-Reine near Paris.[40] The house offered the occasion to exhibit the various solutions for the construction of wall surfaces: thin structural walls, thick walls with air voids, glass walls, light partitions. According to Gwenaël Delhumeau, the facades were an experiment in the wrapping and casing of a building in reinforced concrete.[41] The facades often betrayed the attempt to create an impression of thickness, with an infill of concrete revetment panels akin to a regular stone dressing. Displaying all the architectural and architectonic possibilities offered by the use of the Hennebique system, this house was an architectural showcase of the modern wall.

Hennebique's research focused on the use of reinforced concrete both for the structure and the external walls. On the rue Danton, he developed the molded wall, which combined a structural skeleton with a continuous enclosing surface. At Bourg-la-Reine, he experimented with the process of frame and infill, using an infill made of specially designed reinforced panels. Yet since most of these experiments probably demanded high technical expertise and great workers' skill, they remained at the level of prototypes. Most

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39 [Paul Gallotti], "Maison de Rapport, rue Danton, n. 1, à Paris", Le Béton Armé, vol. 4, no. 41, October 1901, p. 58.

40 For a thorough presentation of the house, see Gwenaël Delhumeau, "La maison en ciment armé de François Hennebique à Bourg-la-Reine", Revue d'histoire de l'art, 1990, pp. 75-87.

41 Delhumeau (see note 40), p. 78.

architects opted instead for the conventional method of frame and infill, and the use of modern infill materials such as terra-cotta, brick, and ceramic.

This was the case with the architect Jules Lavirotte who designed a residential building (1899-1901) on the Square Rapp in Paris. The building was noticed for its original use of ceramic revetment. While the two lower storeys were in masonry, the upper storeys were built with the Cottancin system of reinforced cement. The walls were made of threaded bricks covered with glazed stoneware tiles produced by Alexandre Bigot, the ceramic manufacturer. Commenting on the building, Boileau wrote that the system of decorative construction in stoneware adopted by Lavirotte was directly associated with the development of reinforced concrete systems.[42] This early realization was followed by the construction of another building on the same lot, but facing on the Avenue Rapp (1900-01). Also designed by Lavirotte, this apartment building conspicuously covered with glazed stoneware was owned by the manufacturer Alexandre Bigot. The application of glazed stoneware on the facade won him the unanimous favor of the technical press. The Avenue Rapp building also received an award in 1901 in the context of the Concours de façades organized by the Municipal Council of the City of Paris. In their report, the judges credited Lavirotte with an experiment of primary significance: "... it is the first instance of the application of ceramic to current building ... and on such a large scale .... It is unlikely that we shall see very many buildings of this kind in Paris; but M. Lavirotte's enterprise shows what will be feasible in countless circumstances in the future with the use of glazed stoneware...".[43] With Lavirotte's apartment buildings, the use of modern ceramic materials was intimately associated with the threaded brick walls of the Cottancin system of reinforced-cement construction.

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[42] Boileau wrote: "C'est à ma connaissance un des premiers exemples de la véritable construction décorative en grès et, je crois, quant à la manière d'en assembler les pièces, une invention qui dérive du ciment armé, due dans l'espèce à l'un des honorables applicateurs de cette nouvelle méthode, M. Cottancin". L.-C. Boileau, "Causerie", L'Architecture, vol. 14, no. 32, 22 August 1903, p. 312.

[43] Quoted in Franco Borsi, Ezio Godoli, Paris 1900, New York, Rizzoli, 1977, p. 213.

In 1902, the architect Charles Klein designed a residential building on the rue Claude-Chahu in Paris, another award-winner in the Concours de façades of the Municipal Council (fig.17). The entire structure of the building was made of a reinforced-concrete frame based on the Hennebique system. The original construction technique of the building was summarized in La Construction Moderne.[44] The first phase was the construction of a reinforced-concrete frame. The second phase comprised the construction of partition walls and infilling. The third phase concerned the construction of the facade, which was made up of two skins: "One of the skins is a thin wall of stock bricks, to which is fixed the other, formed of thick outsize bricks of Muller glazed stoneware. Between the two an air-cushion provides insulation against cold and heat. The ceramic skin is fitted into a system of vertical metal sections, which are linked by metal horizontal to the brick wall".[45] Reviewing the construction, the critic Charles Saunier noted the logic of assemblage of the stoneware blocks.[46] He stressed that the blocks were not used as a simple veneer destined to hide the structural framework. On the contrary, the blocks were mounted during the construction of the structure and were closely united with it. He also claimed that despite a cost still higher than stone, the use of decorative stoneware appeared as the natural complement to reinforced-concrete construction: "While cement is grey and produces feeble lines, the stoneware enlivens its color while helping to produce sharper edges."[47] In this project, the reinforced-concrete frame was absorbed within the thickness of a wall made out of a modern brick infill and a decorative skin. Reinforced concrete was construed as an auxiliary building system which enabled the development of the modern decorated wall.

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[44] [Anonymous], "Maison rue Claude Chahu, à Paris", La Construction Moderne, vol. 8 (1902-03), pp. 365-366.

[45] La Construction Moderne (see note 44), p. 365.

[46] C. Saunier, "Une nouvelle construction en grès", L'Art décoratif, vol. 5, January-June 1903, pp. 169-175.

[47] Saunier (see note 46), p. 174: "Employé seul, ce matériau si intéressant n'aboutit qu'à un ensemble gris et à des lignes molles. Le grès est appelé à réveiller sa tonalité, à accuser les saillies."

The use of reinforced concrete was not limited to the production of costly apartment buildings. The new material appeared especially appropriate for the construction of low-cost housing, as was the case with a building on the rue Trétaigne (1903-04) in Paris, designed by the architect Henri Sauvage (fig.18). The building was sponsored by the Société des logements Hygiéniques à Bon Marché, presided over by the architect Frantz Jourdain.[48] The project was an initiative of the Société de l'Art Populaire, which was concerned with the beautification of public buildings as well as low-cost housing.[49] In his treatise on low-cost housing and Art Nouveau, Jean Lahor -- the founder of the Société -- pointed out the brilliant effects architects could obtain with the use of faïence or enamelled brick.[50] Yet the low-cost housing project on the rue Trétaigne did not exploit these decorative possibilities. The building was based on the system of reinforced-concrete frame with a brick infill, with both frame and infill left bare to the eye, without any decorative veneer.[51] Sauvage's decision to express the structure could find its justification in the thinking of some building specialists who argued that "reinforced concrete used in monolithic construction could develop an architecture based on the affirmation of the structure", a type of honest and rational decoration most commonly found in industrial buildings.[52] For Sauvage, the expression of the modern wall appeared to be grounded in the precedents of industrial architecture.

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48 The building permit was registered in Jourdain's name in July 1903. See Meredith L. Clausen, Frantz Jourdain and the Samaritaine, Leiden, E. J. Brill, 1987, p. 122.

49 Clausen (see note 48), p. 121.

50 Jean Lahor, Les Habitations à Bon Marché et l'Art Nouveau pour le Peuple, n.d. (1903), p. 81.

51 Loyer argues that the rue Trétaigne building "appears to us much more advanced at this date, in its conception as well as in style" then the famous rue Franklin building by Perret:"where the Perret brothers still resorted to a decorative trimming of sandstone lozenges set in the fresh cement (arranged in floral motifs of Japanese style), Sauvage did not hesitate to show the bare concrete and brick and to base the movement of his façade simply on a rhythm of empty and filled spaces, as a reflection of the interior distribution of the rigid skeleton of the framework". François Loyer, "Sauvage, or the renunciation", Henri Sauvage 1873-1932, Bruxelles, AAM, 1978, p. 43.

52 Christophe wrote: "Le béton armé tel qu'il est employé dans le constructions monolithes peut avoir son architecture propre et c'est souvent à tord que l'on cherche, ailleurs que dans l'affirmation de la structure réelle, des motifs de décoration. Ce type de décoration sincère et rationnel ne se rencontre guère jusqu'à ce jour que dans les constructions industrielles". Paul Christophe, Le béton armé et ses applications, Paris-Liège, Béranger, 2nd ed., 1902, p. 153.

By the early 1900s, the architectural challenge posed by reinforced-concrete construction lay in the conception and expression of the modern wall. Though each building system seemed to favour a particular option regarding wall construction, the choice remained open, and it was left to the architect to decide how to conceive and express the wall. With the 25bis rue Franklin, the Perret brothers offered a forceful interpretation of this new architectural task.

The 25bis rue Franklin

The conception of the rue Franklin apartment building must be set in its context of conception and production. Both Auguste and Gustave Perret worked within the family building firm, which became the 'Entreprise Perret et Fils' in 1896.[53] The Perret firm began to perform the function of both architect and contractor towards the end of the 1890s. While some of its projects were carried out for other architects, others signed by the brother architects were executed by other building contractors. Two projects drawn up by Auguste and Gustave were executed by the Perret firm: a commercial building, 10 rue du Faubourg Poissonnière (1897), and an apartment building, 119 avenue de Wagram (1902).[54] These first achievements were based on the usual technology of the time: cut stone, brick, iron floors, glass walls with metal frames. The 25bis rue Franklin was the Perrets' first attempt at using reinforced concrete for the construction of a load-bearing structure.[55] The general contractor was the firm 'Perret et fils' while the reinforced-concrete work was subcontracted out. All laborers were paid by the day, since the Perret firm did not have its own permanent team of construction workers. The reinforced-concrete work was done by the relatively unknown firm of Latron et Vincent, a public-works contractor, using a construction system very similar to Hennebique's system of

53 On the history of the family firm, see Joseph Abram, "An Unusual Organization of Production: the building firm of the Perret Brothers, 1897-1954", Construction History, vol. 3, 1987, p. 75-93.

54 Abram (see note 53), p. 81.

55 Martin Bressani, "1903-1933, cronaca di un'architettura", Rassegna, no. 28, December 1986, pp. 16-31.

post-and-beam with floor slabs. As general contractor of the work, the architects retained technical control over both the design and the construction process, and were fully able to exploit the resources of the system. The site chosen by the Perrets was exiguous. According to Martin Bressani, the constriction of the site may have aided Auguste Perret in convincing his father to use concrete since it obviated the need for bearing walls and permitted a thinner structure.[56] While the project was largely designed by April or May 1903, construction most likely started in the summer of 1903 and ended in the first half of 1904.

The drawings of the first project dated 10 and 11 May 1903 show a proposal for a thick masonry wall and metal (cast iron) posts for the ground floor (fig.19).[57] The subsequent project, dated 17 May 1903, proposes a system of reinforced-concrete beam with large brackets for the ground floor. Yet the drawings of the upper floors dated 6 and 7 May 1903 already reveal the adoption of a reinforced-concrete structure. The architects' indecision over the construction system to be adopted for the basement and ground floors reveals a reluctance to do away with the traditional thick masonry wall at street level, and the usual dissociation of ground floor from upper floors.

The design of the reinforced-concrete structure was complex: "The basement and ground floors have a structural organization distinct from the upper floors. The heavy piers at the lowest levels are widely spaced to allow a maximum uninterrupted floor area. Above, a more slender and ramified structural frame has a configuration similar to that of the rooms".[58] According to Joseph Abram, the Perrets' way of using the post-and-slab structure was highly significant: "The framework here is totally subjected to architectural choice with the U-shaped classical plan, combining symmetry and asymmetry, determining the location of the piers. The weight is carried on the surrounding masonry

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56 Bressani (see note 55), p. 16.

57 The drawings of the 25bis rue Franklin are preserved at the Centre d'archives d'architecture du XXe siècle, Institut Français d'Architecture, Paris (Fonds Perret, 535 AP 3/3).

58 Martin Bressani, "Rationalism and the Organic Analogy in Fin-de-Siècle Paris: Auguste Perret and the Building at 25b rue Franklin", master's thesis, MIT, 1985, p. 69.

walls, on the concrete posts of the facade and on the piers, the location of which corresponds to the extremities of segments dividing up the space."[59]

The use of a structural frame called for the construction of an infill wall. The infill consisted of a single solid-brick wall, coated on the exterior with a layer of cement to which the stoneware tiles were directly applied. On the interior the coating was a plaster mixed with asbestos fiber to improve weather insulation. But the Perrets' use of the frame and infill system did not mean that the building's exterior articulation offered a transparent account of the actual structural layout.[60] A look at the various drawings shows a great disparity in the size of the various vertical supports (fig.20). Yet, using ceramic tiles applied to the reinforced-concrete framework, Perret managed to make all structural members appear uniform. In fact, Perret did not display the structure in its nudity. On the contrary, he dressed the reinforced-concrete skeleton with ceramic, giving it a more regular appearance.[61] Perret did not express the structure as such, but rather developed a graphic composition of vertical and horizontal lines. This composition -- executed by means of the ceramic-tile revetment -- emphasizes the slenderness of the skeleton. The apparent slenderness of the reinforced-concrete frame and the proportions of full and void achieved an expressive transparency like that of metal construction.

The most striking feature of the building's external wall was the decorative revetment applied to the brick infill (fig.21). This revetment was based on the use of small stoneware pieces embedded in the fresh cement coating the brick wall. Produced by the ceramist Alexandre Bigot, these stoneware elements -- which came in five different motifs -- were arranged to create the effect of natural vegetation. In the introduction to his commercial catalogue, Bigot stated: "The decoration of a façade with ceramic is no longer as expensive as it is with sculpted stone."[62] Bigot's claim was supported by the critic

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59 Abram (see note 53), p. 85.
60 Bressani (see note 58), p. 192.
61 Bressani (see note 58), p. 193.
62 Quoted in the preface to the catalogue Alexandre Bigot, Les Grès de Bigot, Paris, 2nd. ed., 1902.

Charles Saunier who stated that a reinforced-concrete structure sheathed with stoneware tiles was no more expensive than a building made of cut-stone with sculpted decorations.[63] By 1903, reinforced-concrete construction was closely associated with the use of ceramic materials. Yet Perret did not merely adopt the current method of ceramic ornamentation. He devised a decorative system that directly addressed the nature of the modern wall.

The use of ceramic materials in French architecture dated back to the middle of the 1850s. According to G. Vogt, they had played a major role at the Universal Exhibitions of 1878 and 1889.[64] The association of reinforced-concrete construction with ceramic materials stems from the early experiments of Anatole de Baudot with the Cottancin system. Beginning with his own house on the rue Pomereu (1893), de Baudot had favored the use of inlaid glass mosaics and stoneware for the decoration of the cement surfaces and wall infills.[65] In his 1895 lecture before the members of the Union Syndicale des Architectes Français, the engineer Cottancin reiterated this position. Yet he also argued that decorative brick -- enameled brick, stoneware brick, glazed earthenware -- had to be used as an authentic construction material rather than as a simple veneer.[66]

By the turn of the century, the use of ceramic and glazed earthenware in architecture had received greater attention. At the 1900 Universal Exhibition, these modern industrial materials had found applications in the low-reliefs and decorative friezes of the Porte Binet, the fountain of the Cours-la-Reine, the kiosk by Charles Plumet, the pavilion of Grès et Faïences by Provensal, and the pavilion of the Manufactures de Sèvres by

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63 Saunier (see note 46), p. 174.

64 Recalling the comment made by the architect Paul Sédille, Vogt wrote: "L'Exposition de 1878 fut une première manifestation éclatante des terres cuites et émaillées; l'Exposition de 1889 en a été l'apothéose". G. Vogt, "De l'emploi de la Céramique dans la Construction", Art et Décoration, vol. 15, 1904, p. 94.

65 Bulletin de l'Union Syndicale (see note 36), p. 37.

66 Cottancin wrote: "En employant des briques décoratives, telles que la brique blanche ou rouge à arêtes vives, la brique émaillée, des pièces creuses en grès émaillé ou non, de la faïence, on obtient tous les effets décoratifs les plus brillants tout en utilisant, ces produits, réellement comme matériaux de construction et non comme placages n'ayant que peu de valeur, puisqu'ils ne font pas partie intégrante de la construction et se décollent souvent du parement où ils ont été appliqués". Bulletin de l'Union Syndicale (see note 37), pp. 223-224.

Risler.[67] At the exhibition, ceramic materials were used on both reinforced-concrete and metal structures. To give but one example, the multicolored enamel and ceramic patterns that enveloped the minarets, dome, and three arches of the Porte Binet were applied on a metal structure.[68] In the words of the editor of L'Architecture, the 1900 Universal Exhibition had been "the triumph of stoneware tiles".[69] By that time, the use of ceramic materials had also received attention from advocates of the new urban aesthetic. In Esthétique de la rue, published in 1901, the Symbolist poet and art critic Gustave Kahn described the decorative value of ceramic tiles for architects wanting to break away from the traditional monochrome masonry facades.[70] Kahn envisioned the city of the future filled with buildings of polychrome facades, decorated with brightly colored ceramic tile friezes.

In the early years of the new century, most architects were not yet ready to develop such a polychromatic architecture. But many were convinced of the need to use ceramic materials combined with reinforced-concrete construction. In a review of Charles Klein's apartment building, the critic Charles Saunier argued that stoneware was the natural complement to reinforced-concrete construction.[71] In a like-minded article, Louis-Charles Boileau wrote that the invention of reinforced concrete had provided the correct way to build with stoneware.[72] Attentive to the growing interest in the use of ceramic materials, Boileau asked Risler -- the architect of the pavilion of the Manufacture de Sèvres at the

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[67] Boileau (see note 11), pp. 429-435.

[68] On the Porte Binet, see Debora Silverman, Art Nouveau in Fin-de-Siècle France. Politics, Psychology and Style, Berkeley and Los Angeles, Univ. of California Press, pp. 289 ff.

[69] L.-C. Boileau, "Causerie", L'Architecture, vol. 16, no. 34, 22 August 1903, p. 332.

[70] Gustave Kahn, Esthétique de la rue, Paris, Bibliothèque Charpentier, 1901, p. 300.

[71] C. Saunier, "Une nouvelle construction en grès", L'Art décoratif, vol. 5, January-June 1903, p. 174: "Que de progrès depuis 1900 ! A cette époque on n'osait penser encore à employer exclusivement le grès dans la construction.... Le grès semble l'auxiliaire indispensable des constructions en fer ou en ciment armé."

[72] Boileau wrote: "Je résume ce chapitre de construction en appelant l'attention d'abord sur ce fait: que l'invention du ciment armé a décidément fourni la bonne manière de construire en poterie de grès, ensuite sur l'excellence, quant à la solidité, des façades ainsi élevées rue Claude-Chahu et ailleurs, et enfin sur l'inaltérabilité d'aspect réalisée avec ces produits spéciaux des maitres céramistes de notre époque". L.-C. Boileau, "Causerie", L'Architecture, vol. 16, no. 32, 8 August 1903, p. 313.

1900 Exhibition -- to comment on his conception of ceramic architecture. For Risler, the contemporary use of ceramics went hand in hand with the technique of reinforced concrete construction.[73] At the time, many residential buildings built of reinforced-concrete were covered with an exterior veneer made of ceramic tile. Tiles were industrially produced and were believed to be incomparably resistant to weather. This use of ceramic materials implied a revolution in the conception of building facades. Contrary to the traditional method of *ravalement* -- the laying out a posteriori of ornamental motifs in sculpted stone -- the use of ceramic materials required that architects conceive their work as a whole before the opening of the building site.[74] As such, the adoption of modern materials was indicative of a more profound change in architectural conception.

Discussing the decorative system used in Islamic architecture, Viollet-le-Duc wrote in the 1870s: "We must realize that decoration is not a banal ornament that may be used repeatedly for any building; decoration should be implicit starting right from the plan, from the first conception in the interpretation of the program; it is already inscribed in the structure; it holds to the building, not like a piece of clothing, but as muscles and skin on the human body".[75] At the 25bis rue Franklin, Perret used the Bigot glazed stoneware as both a protective and decorative revetment for the the brick infill. The ceramic tiles applied to the structural framework also played a decorative, representational role. For Perret, the ceramic material was not only conceived as a building element but as a decorative skin which gave external appearance to the modern wall.

The critical reception of the rue Franklin building paid great attention to this issue. In his review of the building, the architect Edmond Uhry welcomed the fact that Perret did

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[73] In a letter to Boileau, the architect of the pavilion writes: "J'avoue que, en 1894, lorsque j'ai commencé les études du pavillon, j'ignorais (et je n'étais pas le seul) les ressources du ciment armé dont disposent aujourd'hui les architectes pour d'importants édifices. A cette époque, la céramique était généralement un placage sur murs, un placage qui tenait plus ou moins bien". Quoted in L.-C. Boileau, "Constructions en céramique. Le Pavillon de la Manufacture de Sèvres à l'Exposition de 1900", L'Architecture, vol. 16, no. 51, 19 December 1903, p. 482.

[74] On this question, see Hélène Guéné, "Facciata in ceramica per un edificio in calcestruzzo", Rassegna (see note 26), p. 42.

[75] Viollet-le-Duc, Entretiens sur l'architecture (see note 28), vol. 2, p. 205.

not attempt to develop the artistic expression of the building out of reinforced concrete itself.[76] For Uhry, the new material could only be used as a means of construction, as the skeleton of the building. Such a framework naturally entailed the use of an appropriate dressing to give an artistic appearance to non-industrial constructions.[77] Discussing the artistic treatment of the rue Franklin building, Uhry viewed the ceramic revetment as a dressing for the building elements: "While dressing their construction with uprights, panels, and infill of glazed stoneware, the Perrets have frankly expressed in the decoration the constitutive elements of their work."[78] The complementarity of the ceramic material with the cement mixture was further emphasized by means of a metaphorical statement: "Ceramic embedded in the soft mortar may be said to replace the ordinary aggregate: It is rich concrete on top of poor concrete to use the Perrets' own terms".[79] For both Uhry and Perret, the glazed-stoneware pieces and ceramic tiles were deemed to be the natural ornamental complement to the modern building with a skeleton in reinforced concrete.

As his use of ceramic materials suggests, Perret never intended to leave the structural frame exposed to the eye. He sought instead to represent the reinforced-concrete skeleton, the system of frame and infill. As such, Perret's design approach for the rue Franklin building was not based on a search for the *vrai* (truth) in architecture, but was more likely an attempt to achieve the *vraisemblable* (verisimilar). And yet, the use of ceramic material will induce a confusion between the frame and its representation.

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[76] Uhry seems to make reference to the works of Arnaud rue Danton (1900), and Auscher rue de Rennes (1904), where reinforced concrete was treated as a plastic material. Edmond Uhry, "Une maison à Paris", L'Art décoratif, vol. 6, no. 71, August 1904, pp. 51-60.

[77] Uhry wrote: "Il a fallu radicalement s'affranchir de cette conception et n'utiliser le ciment armé que comme moyen de construction proprement dit, formant pour ainsi dire l'ossature, le squelette du bâtiment. Ce n'est qu'en habillant cette ossature d'une parure intéressante qu'on est parvenu à donner la vie, l'aspect artistique aux constructions qui ne devaient pas rester à l'état de locaux industriels". Uhry (see note 76), p. 55.

[78] Uhry (see note 76), p. 56: "tout en habillant leur construction de montants, de panneaux ou de remplissages en grès flammé, ils ont cependant accusé de façon très franche dans la décoration les éléments constitutifs de leur oeuvre."

[79] Uhry (see note 76), p. 56: "Ces feuilles prises dans la pâte ordinaire remplacent pour ainsi dire les cailloux ordinaires: béton riche sur béton pauvre, comme le qualifient MM. Perret."

Reviewing the building a few years later, Robert Mallet-Stevens wrote: "The whole building is of reinforced concrete, so that structural walls are dispensed with. A few supports only, uphold the building, and the rooms are divided by thin partitions. In front the divisions are clearly shown by bold simple lines. The structural part is shown by the cement itself, and the spaces in between are very naturally filled with faience".[80] Mallet-Stevens correctly read the facade as a representation of the building system and the modern wall. But, focussing on the frame, he failed to distinguish between the actual concrete skeleton and its decorative tile revetment.

The reception of the rue Franklin building naturally entailed a discussion of its place in the evolution of Art Nouveau. For most reviewers, the work of Perret embodied a reasonable attitude which contrasted with the excesses of the Modern style. This interpretation was put forth as early as 1904 by Uhry in L'Art décoratif.[81] It was also the position defended by the critic Marc Croisilles in his contemporary review of recent achievements in Parisian apartment buildings.[82] For Croisilles, modern materials provided the means to overcome the increasing excesses of the Modern style. Both the rue Trétaigne building by Sauvage and the rue Franklin by Perret were viewed as decisive progress beyond the mistaken essay of the architect Auscher in the rue de Rennes, where the new material was used for its plastic quality.

In 1908, Charles Saunier wrote a detailed assessment of the applications of glazed stoneware in architecture.[83] Saunier argued that stoneware, which developed parallel to reinforced concrete, was the perfect complementary material.[84] Yet to be meaningful, the

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80 Rob. Mallet-Stevens, Jacques Roederer, "Notes from Paris", The Architectural Review, vol. 23, January-June 1908, p. 257.

81 Uhry wrote: "Ceux-là n'ont pas cru nécessaire pour s'affirmer de torturer les formes de l'ossature de leur construction, de faire une décoration luxuriante, qui le plus souvent ne répond à rien et ne nous étonne que par son incohérence." Uhry (see note 76), p. 54.

82 Marc Croisilles, "Maisons d'aujourd'hui et de demain", La Construction Pratique, no. 27, 1 October 1905, pp. 431-435.

83 Charles Saunier, "Nouvelles applications du grès flammé au revêtement des façades", L'Architecte, vol. 3, no. 11, November 1908, pp. 83-87; no. 12, December 1908, p. 91-94.

84 Saunier wrote: "Le grès flammé, qui a prospéré en même temps que le ciment armé, semble le palliatif indispensable, le matériau complémentaire par excellence, celui qui permettra dans la presque totalité des

use of concrete depended on the decorative method adopted: "If reinforced concrete is completely concealed under richer revetments, it looses all significance and becomes expensive to use without having the attractiveness of rare materials".[85] Saunier explained that the first use of reinforced-concrete frames in architecture paralleled the development of the Modern style. Yet a rejection of the excesses of the Modern style followed, giving way to a more restrained and sober attitude. Saunier illustrates these changes by contrasting the works of Lavirotte and Perret. While Lavirotte used glazed stoneware to create volumes and colors, Perret used glazed stoneware to obtain a decoration which was sober and more geometric. For Saunier, this subdued attitude had to be reflected in the decoration of the concrete itself. He suggested to use "neither rough cement, nor ornamental facing without any link with the constructional method, but a rational marriage of the two in a proportion determined by the character and the purpose of the building."[86] The best example of this new sobriety was Paul Guadet's Hôtel Carnot on the avenue Elysée-Reclus commissioned in 1906, and completed in 1908. Designed by Guadet, the main structure (*gros oeuvre*) of the house based on a reinforced-concrete skeleton was executed by the Perret Brothers building firm. Emulating the Perrets' conception of the modern wall, Guadet designed the Hôtel facade as an ornamented skin (fig.22). According to Saunier, this modern approach to the revetment of reinforced concrete construction was rooted in Perret's original experiment. Though the Perrets did not repeat the experience of the rue Franklin -- with the exception of their original project for the facade of the rue de Ponthieu garage (1906-07), a project contemporaneous with the construction of the Hôtel Carnot -- their conception of ceramic revetment had become a true model for the constitution of the modern wall.

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cas de recourir aux avantages appréciables offerts au constructeur par le ciment armé." Saunier (see note 83), p. 83.

[85] Saunier (see note 83), p. 83: "Si le ciment armé est entièrement masqué sous des revêtements riches, il perd toute signification et devient d'un emploi coûteux sans avoir l'attrait des matières rares."

[86] Saunier (see note 83), p. 84: "ni ciment brut, ni placage ornemental sans lien avec la méthode constructive, mais mariage rationnel de l'un et de l'autre dans une proportion déterminée par le caractère et la destination de l'édifice."

The implied structuralism and rationalism of the 25bis rue Franklin must therefore be understood in light of the Perrets' conception of ornamentation. In the rue Franklin building, the asymmetries and irregularities of the skeleton are strategically corrected thanks to the symmetrical composition of the ornamented facade. And the structural material is keenly concealed by the ceramic revetment. As such, the Perrets' early manifestation of structural rationalism appears to have been deeply rooted in the realm of architectural verisimilitude.

3. Tectonics and Ornamentation

The completion of Auguste Perret's rue Franklin building coincided with the inauguration of the church of St-Jean-de-Montmartre (1896-1904) conceived by Anatole de Baudot. The realization of the church had been a long process. While the first studies dated back to the architectural competition held in 1894, de Baudot was entrusted with the project in 1896. Construction was finally completed in 1904, after several interruptions.[87] The longest of these (between 1899 and 1902) was triggered by the uncertainty of the Town Council regarding the strength of the work. The complex legal battle which ensued resulted in the exclusion of the original entrepreneur, Paul Cottancin, who was replaced by his collaborator Gustave Degaine. During the eight years which elapsed between the original design and the completion of the building, de Baudot had been an active advocate of the application of reinforced cement in architecture. The completed church was the first major example of architecture built with reinforced cement and based on rationalist design principles. Yet between 1896 and 1904, many architects had ventured to use the new system for the construction of commercial and apartment buildings. If the church in 1896 was a pioneering project, a genuine architectural manifesto, by 1904 its doctrinal program could already be measured against other realizations.

[87] The exact chronology of the project has not been established with certainty. But the various evidence gathered supports the conjecture that de Baudot was probably entrusted with the project in 1896.

Comparing de Baudot's church with Perret's apartment building, Kenneth Frampton writes: "No two works, ostensibly deriving from the precepts of Viollet-le-Duc, could be more opposed than Perret's 25 bis rue Franklin apartments and de Baudot's church in Montmartre. Where the one embraced the Hennebique system of reinforced-concrete construction, the other categorically rejected it, not only because, unlike Gothic architecture, it failed to reveal the patterns of stress induced in its structural members, but also because it was incapable of generating an architectonic syntax arising out of the constructional process".[88]

For Frampton, it is the search for architectonic expression which enticed de Baudot to develop a unique system of "reinforced brick and concrete construction" in collaboration with the engineer Paul Cottancin. He further suggests that the early rejection of reinforced concrete and the development of reinforced cement was a direct consequence of de Baudot's interest in tectonic expression.[89] Frampton correctly points out de Baudot's indebtedness to Viollet-le-Duc's structural rationalism. Yet the application of the principles of structural rationalism demands further scrutiny. In the following section, I argue that with reinforced cement, de Baudot attempts both to restore the lost unity between frame and infill and to retain the potential for tectonic expression. Viewed as an attempt to reconcile these two Rationalist tenets, the building is emblematic of the mutation of structural rationalism.

The church of St-Jean-de-Montmartre

The church of St-Jean-de Montmartre was entirely built with the Cottancin system based on the use of threaded bricks and reinforced cement. At first, the plan of the church

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[88] Kenneth Frampton, "Louis I Kahn and the New Monumentality, 1944-1972", Design Book Review, no. 28, Spring 1993, p. 8.

[89] Frampton writes: "The shortcoming of reinforced concrete from a tectonic standpoint had long been perceived by Viollet-le-Duc's prime pupil, Anatole de Baudot, above all, in his church, St-Jean-de-Montmartre, under construction in Paris from 1894 to 1904. De Baudot, educated by both Henri Labrouste and Viollet-le-Duc, carried the legacy of Structural Rationalism into the twentieth century". Frampton (see note 88), p. 8.

appears simple. It is based on a three-aisled nave with lateral chapels (fig.23). Yet the distribution of the piers and vaults of the structural system does not correspond to the arrangment of the conventional church plan. "The roof of the tall church consisted of three vaults supported by a network of ribbings arranged on a diagonal plan, which crossed each other, creating a balance and dividing the smaller vaults into compartments; these were in turn continued by the reinforced cement and brick pillars".[90] The armatures of the pillars were in continuity with the ribs of the upper elements of ceilings, terraces, and vaults (fig.24). Together, the arches and ribs formed a three-dimensional, reticular framework stabilized by the roof. The Cottancin system was also used to constitute the curved surfaces and the level slabs. According to a contemporary review, the roof "constituted a gigantic web made possible by the continuity of the metal and the welding of the cement."[91] The continuity of the metal mesh wove a monolithic construction.

De Baudot's understanding of the new building material was very different from Perret's. For Perret, reinforced concrete was primarily used for the construction of the structural skeleton. He did not seek to expose the frame but only to represent it. For de Baudot, reinforced cement was conceived as a new stage in the development of nineteenth-century iron-skeleton construction. Reinforced cement was not understood as a substitute for but as an improvement of metal construction. It was a step in the evolution of an architecture indebted to iron construction, advancing its structural principles while correcting its major defects. Yet for de Baudot, reinforced cement was more than a structural material. It permitted the construction of unitary structures characterized by their monolithism while presenting the opportunity to restore the lost unity between the structural frame and the wall infill.[92] For de Baudot, the main task was to develop a

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90 Marie-Jeanne Dumont,"The Philosophers' Stone: Anatole de Baudot and the French Rationalists", Rassegna, no. 49, 1992, pp. 38-39.

91 Le Moniteur des travaux publics, 15 April 1905, p. 341: "une gigantesque ramification par la continuité du métal et la soudure du ciment."

92 De Baudot wrote: "La question architectonique et architecturale se pose nettement et pour la résoudre, l'architecte, en faisant intervenir un genre de matériaux particulier, s'inspire d'un principe nouveau de construction: celui de la solidarité générale des ouvrages avec unité de structure." Anatole de Baudot, L'architecture, le passé, le présent, Paris, Henri Laurens, 1916, p. 179.

unitary structure that possessed an architectonic expression, acknowledging both the homogeneous and tectonic character of the structure.

The architectonic expression of the church at Montmartre was further developed by means of the ornamentation. The interior finishes of the church were plaster with a painted decoration, a coating deemed necessary to correct the irregularities of the edges and surfaces made of brick or cement.[93] The external walls were made of exposed brick threaded with a metal wire and filled with cement. The exterior decoration consisted of the use of glazed stoneware *pastilles* (round pieces) inlaid in the fresh cement. The cement itself remained visible between the *pastilles*.

Beginning with his house on the rue Pomereu (1893), Anatole de Baudot advocated the use of inlaid glass mosaics and stoneware in combination with reinforced cement.[94] The publication of two articles in the Bulletin de l'Union Syndicale des Architectes Français confirmed the interest of the Rationalists for these new industrial materials. An article on ceramic and architecture signed by Frantz Jourdain appeared in 1898.[95] It was followed in 1900 by the publication of a report on the ceramics and stonewares produced by the manufacturer Alexandre Bigot.[96] These articles appeared while de Baudot was still designing the church facade. His use of stoneware accorded with current conceptions of cement and ceramic as complementary materials. Yet contrary to Perret, who used the Bigot stoneware to protect and ornament the wall infill, de Baudot employed the stoneware *pastilles* for the ornamentation of the structural members.

De Baudot's ornamental conception stood in sharp contrast with Viollet-le-Duc's approach to decoration. In the second volume of his Entretiens, Viollet-le-Duc had

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93 Chaine wrote: "Le gros oeuvre intérieur de l'Eglise, sauf la balustrade des galeries, est entièrement revêtu d'un enduit en plâtre, nécessaire pour rectifer les irrégularités des arêtes et des surfaces, soit en briques, soit en ciment". [Henri Chaine], "L'Eglise St-Jean-de-Montmartre. Conférence de M.H. Chaine", La Construction Pratique, no. 22, 1 May 1905, p. 29.

94 Bulletin de l'Union Syndicale (see note 36), p. 37.

95 Frantz Jourdain, "La céramique et l'architecture", Bulletin de l'Union Syndicale des Architectes Français, no. 20, Augustt 1898, pp. 688-692.

96 [Anonymous], "Rapport sur les grès flammés de MM. Bigot et Cie.", Bulletin de l'Union Syndicale des Architectes Français, no. 21, September 1900, pp. 621-629.

illustrated an iron-frame house, the structure manifestly laid bare, with infill panels of enamelled brickwork (fig.25). In this project, the chromatic decoration was permitted only on the non-structural elements.[97] With the design of St-Jean-de-Montmartre, de Baudot reversed this scheme, setting his overlay of ceramic mosaics on the structural frame and leaving the infill unadorned. The stoneware ornamentation was mostly applied to the porch and belfry of the church facade. This use of ceramic tended to underscore the presence and role of the cement frame, and this despite the fact that the Cottancin system distributed the load-bearing task to all the constituant parts of the building.

The structural system of the church was very much inspired by the Gothic model. But its ornamentation pointed to other sources of influence. The ornamentation of the structure made reference to the Byzantine model of decorated construction, while another source of inspiration can be traced back to a style in fashion at the 1900 exhibition, a combination of neo-Baroque, Art nouveau, and Orientalist architecture characterized by bright inlaid decoration.[98] Yet de Baudot's application of ceramic materials was only tangentially related to Art nouveau. Contrasting with the ornamental compositions of Lavirotte, in which the entire wall surfaces were clad with glazed stoneware tiles, de Baudot used ceramic primarily for the enrichment of the cement itself.

The completion of the church offered the architect Henri Chaine the occasion to put forth the position of the Rationalist school.[99] For Chaine and the Rationalists, the two modern materials were iron and reinforced cement. But architects had lost control over the shape of iron elements, which came in sections produced by industry. It was a lack of control not entirely regretted, however, since metal presented many deficiencies that

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97 Robin Middleton, "Colour and cladding in the nineteenth century", Daidalos, no. 51, March 1994, p. 83.

98 Françoise Boudon, "Recherche sur la pensée et l'oeuvre d'Anatole de Baudot, 1834-1915", AMC, no. 28, March 1973, p. 65.

99 Henri Chaine, "L'Église St-Jean-de-Montmartre. Conférence de M. H. Chaine", La Construction Pratique, no. 21, 1 April 1905; no. 22, 1 May 1905; no. 24, 1 July 1905; no. 25, 1 August 1905. The information sheet titled L'Union des Architectes, a new vehicle for the rationalist school, was inserted in the journal La Construction Pratique (1904-1906).

seriously limited its applications.[100] Chaine actually proposed abandoning the use of iron altogether, arguing that rational construction in reinforced cement was fated to bring about a revolution in both building methods and architecture.[101] Central to this revolution was the fact that reinforced cement radically transformed the traditional functional elements of architecture: pillars, walls, arches, vaults. The unitary structure achieved by means of the metal mesh would cause these functional elements to disappear.[102]

In Chaine's review, the system of reinforced cement used for the construction of the church was closely identified with Anatole de Baudot, limiting Cottancin's contribution to the function of entrepreneur. This apparent usurpation of the system was angrily contested by Cottancin himself.[103] In his published response, Cottancin stressed that during the construction process, de Baudot had always placed the responsibility regarding the building system on the shoulders of the entrepreneur. Yet in Chaine's review, Anatole de Baudot was now presented as the inventor of the reinforced rib, a key feature of the system. By 1905, the system of threaded brick with reinforced cement had been entirely appropriated by the Rationalists, turning it into the technological paragon of their architectural doctrine.[104]

The critical reception of the church, which was reviewed in most architectural and construction periodicals, was generally positive. In La Construction Pratique, the critic Marc Croisilles wrote that with this project of reinforced cement made a startling demonstration of its many virtues.[105] Describing it as a sort of "kneadable stone",

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[100] Chaine, 1 April 1905 (see note 99), p. 22.

[101] Chaine wrote: "Le ciment armé, employé en raison de ses aptitudes, doit donc être, comme on le voit, le bouleversement complet de tout ce qu'ont été, jusqu'à présent, la construction et l'architecture". Chaine, 1 May 1905 (see note 99), p. 29.

[102] Chaine wrote: "C'est le maillage métallique ininterrompu qui tient tout, qui doit faire de toute la construction un monolithe indéformable. Et, de ce seul fait, découle naturellement la conséquence qu'il n'y a plus rien, dans un édifice en ciment armé, qui joue le rôle des organes dont nous parlions tout à l'heure; c'est-à- dire qu'il n'y a plus en réalité ni piles, ni murs, ni arcs, ni voûtes." Chaine, 1 May 1905 (see note 99), p. 28.

[103] P. Cottancin, "A propos de L'Eglise St-Jean-de Montmartre", La Construction Pratique, no. 25, 1 August 1905, pp. 52-53.

[104] Cottancin himself continued to use the system until the First World War.

[105] Croisilles (see note 82), p. 434.

Croisilles claimed that this new process would give birth to a "new beauty".[106] Yet architectural journals closer to professional circles were more circumspect. Their reviews were generally conditioned by the doctrinal leaning of the periodical. Indeed, any comment on the project naturally led to a discussion of the doctrine itself. The publication of Anatole de Baudot's L'architecture et le ciment armé shortly after the completion of the church served to encourage these doctrinal debates.[107]

De Baudot's manifesto was reviewed in the major architectural periodicals.[108] Louis-Charles Boileau's review of St-Jean-de-Montmartre was formulated as a response to de Baudot's theoretical assumptions. Both de Baudot and Boileau had become senior figures of French architectural circles. If their never-ending dispute did not necessarily reflect the positions of the younger generation of architects, it nonetheless reflected the state of architectural theory and criticism by the mid-1900s.

Boileau's review was framed by a discussion on the essence of architectural materials.[109] He praised de Baudot's idea to use the great arches to generate the space and the cupolas. He equally praised the treatment of the external surfaces, with the predominant red brick and the mosaic decoration inlaid in the cement. But he vehemently criticized the architect's submission to a single system of construction. Arguing that there was a variety of systems which could offer appropriate combinations, Boileau repeated his belief that reinforced cement was not a homogeneous material entity but only an assemblage of two distinct components.[110] Boileau questioned the validity of defining

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106 Croisilles wrote: "Nous avons un procédé neuf pour faire de la beauté neuve, un moyen admirable qui se plie à toutes les combinaisons, en quelque sorte une pierre pétrissable qui est en même temps la Souplesse et la Force". Croisilles (see note 82), p. 434.

107 Anatole de Baudot, L'architecture et le ciment armé, Paris, n.d. (c. August 1905).

108 See the review of L'architecture et le ciment armé by Eugène Dupuis in L'Architecture, vol. 18, no. 37, 16 September 1905, pp. 351-52; see also: [Anonymous], "L'architecture et le ciment armé. Brochure de A. de Baudot", La Construction Moderne, vol. 21, no. 9, 2 December 1905, p. 103.

109 L.-C. Boileau, "Le ciment armé et l'art de l'architecte", L'Architecture, vol. 18, no. 51, 23 December 1905, pp. 471-473.

110 Boileau (see note 109), p. 473.

reinforced cement as a *matériau*, a building material.[111] Arguing against the Rationalists' claim that reinforced cement could furnish at once the skeleton, the muscles, and the skin of buildings, he insisted that it be viewed as an assemblage of cement reinforced with iron.[112] Boileau's discussion directly addressed Rationalist claims regarding the formal determinism assigned to the new system. Since reinforced cement was not an authentic material but the assemblage of two components, it could not provide the basis for the development of a true structural and decorative expression. For Boileau, iron could not be conceived as a *matériau* simply for its mechanical fabrication, which was foreign to artistic sentiment. Reinforced cement, with its metal armature assembled according to mathematical calculation, suffered from the same limitation. Cement remained an unattractive dark grey substance, dreary and sad, like all similar substances mixed with water. In a later discussion on reinforced cement vis-à-vis other building materials, Boileau argued that it would not replace the iron of large constructions, in the same way that iron did not replace stone or brick, and did not suppress the use of wood.[113] Comparing reinforced cement with exposed iron, Boileau stressed that they were both pure "means of construction", and that both lacked aesthetic qualities.[114]

The completion of the church also triggered a debate on the notion of architectural beauty. In his review article, Chaine had argued that beauty was not a given, but a

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[111] Boileau wrote: "Mais pourquoi cet assemblage ne serait-il pas exactement ce qu'il est: du ciment armé de fer, ou plus simplement dit: du ciment armé, avec un trait d'union si l'on y tient, mais plutôt un nouveau *matériau* ?" L.-C. Boileau, "Le nouveau matériau", L'Architecture, vol. 18, no. 48, 2 December 1905, pp. 442-443.

[112] Boileau wrote: "Les mêmes sincéristes crient à cette heure: <Vive le ciment armé!> sous le seul prétexte que ce nouveau matériau (?) peut fournir non seulement les os, mais encore les muscles et le derme des surfaces des édifices". L.-C. Boileau, "Le ciment armé et l'art de l'architecture", L'Architecture, vol. 18, no. 49, 9 December 1905, p. 455.

[113] In a letter to Le Béton Armé, Boileau wrote: "Evidemment le ciment armé ne remplacera pas le fer de grande construction dans tous les cas pas plus que le fer n'a remplacé la pierre ou la brique, pas plus qu'il n'a amené la suppression totale du bois: chacun des moyens que nous connaissons aujourd'hui a son meilleur emploi dans telle ou telle circonstance déterminée". In Paul Gallotti, "Le béton de ciment armé, avantages et inconvénients", Le Béton Armé, vol. 10, no. 112, September 1907, p. 136.

[114] Boileau wrote: "Maintenant - cela est bien entendu - le ciment armé, comme aussi bien le fer apparent, représentent l'un et l'autre de purs *moyens de construction*. Ils ne sont pas esthétiques, toute la différence entre eux vient de ce que le ciment se présente avec des surfaces décorables, tandis que le fer travaillee par les machines n'en présente à peu près aucune; il faut y ajouter ces surfaces, l'y noyer la plupart du temps". Gallotti (see note 113), p. 136.

convention. "The idea of beauty in the arts is therefore only a question of education and habit."[115] For Chaine, the constitution and components of St-Jean-de-Montmartre were so different from those of traditional buildings that it was as yet impossible to assess their beauty. He wrote that "in order to be able to appreciate this building's aesthetic value, it is necessary to gradually transform our education, to gradually become accustomed to the new forms and configurations presented to us."[116] In a veiled response to Chaine, Boileau rejected any claim that the use of the new system could trigger the development of a "new beauty" and "unknown decors".[117] The architect Eugène Dupuis also sustained this argument, refuting the Rationalist's association of reason and logic with art and beauty.[118] Despite its many incursions into the domain of technique and materials, the debate between Boileau and the Rationalists was fundamentally about architectural principles, about the source and essence of artistic conception. The aesthetic promoted by the Rationalists was deemed to be generated by, to emerge out of the new material. Yet at St-Jean-de-Montmartre, the forms were designed rather than calculated, and the autonomy of the building specialist proved to be limited, as technical and artistic control was held by the architect. As such, the Rationalists were actively engaged in the design of the "new architectural beauty", a beauty that proved to be fundamentally intentional rather than merely "natural".

Like Perret's 25bis rue Franklin, de Baudot's St-Jean-de-Montmartre remained a prototype in contemporary research into new materials, but the two buildings were very different works. With the 25bis, the skeleton (designed by the architect and calculated by

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[115] Chaine, 1 July 1905 (see note 99), p. 45: "L'idée de la beauté n'est donc, comme vous le voyez, dans les arts, qu'une question d'éducation et d'habitude."
[116] Chaine, 1 July 1905 (see note 99), p. 45: "il faut pour pouvoir en apprécier la valeur esthétique, que notre éducation se fasse peu à peu à cet égard, que nous prenions doucement l'habitude des formes et des dispositions nouvelles qui nous sont présentées."
[117] Boileau wrote: "Mais quant à dire encore, avec des littérateurs avides de nouveautés, que l'union du fer et du ciment doit susciter des formes de *beauté nouvelle* et des *décors non déjà vus*, autant vaudrait prétendre que la structure de la voûte en berceau de la Chapelle Sixtine a été le point de départ du génie de Michel-Ange". L.-C. Boileau (see note 109), p. 473.
[118] Eugène Dupuis, "La raison, la logique, le beau, l'art", L'Architecture, vol. 18, no. 33, 19 August 1905, p. 315.

the building specialist) was adapted to the plan and the form. With St-Jean-de-Montmartre, the skeleton defined the plan and the form. With the 25bis, Perret proposed a representation of the frame and infill system in a search for architectural verisimilitude. With St-Jean-de-Montmartre, de Baudot struggled to retain both the unity of the structure and the expression of the frame, in a constant search for architectural truth.

For both de Baudot and Perret, as well as for many other architects, the use of reinforced cement or concrete was naturally complemented by the use of ceramic materials. Yet while Perret was concerned with the decoration of the wall surface (the skin over the skeleton), de Baudot was concerned with the ornamentation of the structural frame itself. For Perret, reinforced concrete was still approached as a building system. As such, the 'exposition' of the external material (the cement) was not on the aesthetic agenda. For de Baudot, reinforced cement was conceived as a new material. It explains his concern for the external appearance of the material, the ornamentation of the cement surfaces.

Auguste Perret and Anatole de Baudot displayed a very different understanding of Rationalist principles, revealed in their approach to tectonic expression and ornamentation. With Perret, the concrete framework was sheathed in broad ceramic tiles, while the infill was covered with decorative mosaic pieces. This approach emphasized the contrast between the un-patterned framework and the "colored and patterned" infill. With de Baudot, the proprieties of the new system challenged the conventional notion of frame and infill. The unitary structure achieved by the combination of threaded bricks and reinforced cement conflicted with the conventional Rationalist distinction between functional members. Ultimately, it came to challenge the conventional definition of architectural Rationalism itself.

Rationalist experiments

The architectonic research of Anatole de Baudot was emulated by a number of architects trained at the Palais du Trocadéro. De Baudot held a chair in the history of French architecture established in 1887 and housed at the Trocadéro. The courses offered aimed at the training of architects destined to work for Government offices. Over the years, de Baudot developed a following of students faithful to Rationalism, and from the turn of the century until 1914, the works of de Baudot's students were regularly exhibited at the Salon d'architecture. Promoted by the Société Nationale des Beaux-Arts, the Salon d'architecture (created in 1893) attracted many dissidents from the academic tradition: the architects of Rationalist, symbolist, and Art nouveau tendency.[119] The Salon d'architecture housed a regular display of rationalist projects: villas, residential buildings, restaurants, churches, most of them in reinforced cement and bricks.

The period which followed the completion of the church of St-Jean-de-Montmartre was the most inventive and prolific in terms of architectural exploration. De Baudot himself exhibited a number of projects, many for residential buildings: a modern house in 1906, a low-cost housing project in 1908, a residential building in 1911, an architect's house in 1912. Between 1910 and 1914, de Baudot also made a number of studies for large covered public halls. These later projects are illustrative of his search for a new aesthetic based on different planning and structural solutions.[120] Yet it is the housing projects which are most telling for de Baudot's evolving approach to structure and ornamentation. They reveal a basic design concern for the interlocking of volumes rather than the melding of lines (fig.26). This emphasis on the wall surface rather than the structural skeleton was translated into the ceramic decoration. These projects indicate a renewed interest in the ornamentation of the brick wall infill. Though the structural elements were still enlivened with inlaid ceramic, the wall surfaces were decorated with patterns in brick and ceramic tile.[121]

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119 Dumont (see note 90), p. 40.
120 H. Saladin, "L'Architecture au Salon de 1913", L'Architecture, vol. 26, no. 23, 7 June 1913.
121 Boudon (see note 98), pp. 65-66.

The projects exhibited by de Baudot's students also illustrate the changing dialectic between tectonic and ornamentation. In a review of the 1906 Salon d'architecture, Charles Plumet wrote that the majority of the projects expressed Rationalist convictions.[122] Of the projects exhibited, Plumet mentions a modern house by de Baudot, a fish market by Emmanuel Chaine, and a villa by Julien Polti, all of which were based on the use of reinforced cement and threaded bricks. The fish market by Chaine -- a former draughtsman in de Baudot's studio -- emphasized the boldness of the roof structure.[123] In this project, the very nature of the building system was concealed under the expression of the form.

The 1907 Salon d'architecture again provided many examples of Rationalist projects, for instance the designs for modern houses by André Collin and Joachim Richard.[124] Collin's design focused on the volume and the unadorned brick wall surfaces, while Richard's house emphasized the structural skeleton ornamented with ceramic fragments. Also exhibited was Emile Chaine's competition project for a People's House in Paris, a project promoted by a worker's cooperative (fig.27).[125] The use of both reinforced cement and reinforced concrete in the construction of workers housing was becoming a topic of discussion within French architectural circles. At the International Congress of Architects held in London in 1906, Adolphe Augustin-Rey (the architect of the Fondation Rothschild) offered a detailed study of the use of reinforced concrete in the construction of low-cost housing.[126] The use of a structural frame was to have a direct impact on the general form of the building: the suppression of the attic and its replacement by a terrace, etc. Chaine's winning project was realized two years later,

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[122] Charles Plumet, "Le Salon d'architecture à la Société Nationale des Beaux-Arts", L'Architecte, vol. 1, 15 May 1906, pp. 35-37.

[123] See Emile Chaine, "Dispositions générales relatives aux halles aux poissons", Le Béton Armé, vol. 12, no. 136, September 1909, pp. 137-138.

[124] La Construction Moderne, vol. 24, 11 January 1908, p. 174.

[125] For Chaine's project, see [Anonymous], "La maison du peuple à Belleville", La Construction Moderne, vol. 22, 8 June 1907, pp. 425-428.

[126] Adolphe Augustin-Rey, "Les constructions en acier et ciment armé", International Congress of Architects (Seventh session held in London 16-21 July 1906), London, 1908, pp. 188-204.

but in an extremely reduced version, after most of the "baroque exuberance" that characterized the exhibited project had been removed.[127] Yet the final drawings of the facade (dated January 1909) showed that both the structural frame and the wall surfaces were to be ornamented with ceramic materials.

Most of these projects were a direct offshoot of the design method first formulated by Anatole de Baudot. They illustrate the difficulty, embedded in the building system itself, of fidelity to the principles of structural and material honesty. With the homogeneity provided by the weaving of the cement ribs and the threaded bricks, the distinction between structure and infill became a matter of design choice rather than of technical determination.

According to Rationalist doctrine, new architectural forms were to develop from the appropriate use of new materials. In 1910, Henri Chaine reiterated the Rationalist belief that reinforced cement was the only material that could spawn a new architecture.[128] De Baudot's realizations with the Cottancin system presented forms deemed to derive from the inherent logic of the system. Yet in the many projects in reinforced cement and brick exhibited at the salon d'architecture, the forms seemed to precede or be forced upon the system. As such, these Rationalist projects generated a new formal syntax apparently independent from any technical determination.

The many experiments conducted during the first decade of the century offer telling proof of the relative independence between building systems and formal expressions.[129] It fact, the system devised by Cottancin could be used to accommodate various architectonic and decorative expressions. The Hôtel des Postes of the Cité Martignac

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[127] Dumont (see note 18), p. 41.

[128] Chaine wrote: "....j'ai le droit de dire que le ciment armé est un véritable procédé de construction nouveau, fécond et intéressant, tandis que le béton armé n'est en quelque sorte qu'un truc permettant de donner les formes de la pierre ou du marbre à une véritable construction en fer qui, étant masquée, n'a plus besoin, au lieu d'assemblages soignés et coûteux, que d'être constituée par de grossières ligatures". In Henri Chaine, "Communication de M. Chaine sur le ciment armé au Congrès des Intérêts généraux du Bâtiment de 1910", Le Rationaliste, 5th ser., no. 58, June 1914, p. 855.

[129] I wish to question Frampton's view, according to which the Rationalists' adoption of the Cottancin system was motivated by its capacity to generate "an architectonic syntax arising out of the constructional process." Frampton (see note 88).

(1907), designed by François Le Coeur (1872-1934), is a case in point. In this project, the Cottancin system was used for the construction of both the structure and the walls of the building. But here the structural frame was concealed by the threaded brick infill, which remained devoid of any ceramic decoration.

The independence of building system and formal expression can be further substantiated by looking at the work of the architect Joachim Richard (1869-1960). A former student of de Baudot, Richard adopted the Hennebique system of reinforced concrete construction. The system was applied in two of his early projects: the apartment building rue Perrichont (1907-08) (fig.28) and the hôtel particulier rue Boileau (1908), both in Paris. In these projects, the architect merges the potential of the Hennebique frame with the picturesque details and inlaid ceramic decoration developed by de Baudot. Following Perret's approach, Richard emphasized the duality of structure and infill. Following de Baudot's teaching, he continued to face with ornamental ceramic the beams and pilasters of the reinforced-concrete structure. This mode of decoration was advocated by Gaston Trélat, director of the Paris Ecole Spéciale d'Architecture. At the International Congress of Architects held in London in 1906, Trélat called for the use of inlaid decoration based on terracotta and glazed stoneware. Arguing against the renaissance method of *placage* (facing), Trélat sought the intimate marriage of structure and decoration.[130]

Richard's works were well represented in Hennebique's commercial journal Le Béton Armé, for they served to illustrate Hennebique's belief in the potential of the system for the development of architecture.[131] For many building specialists like Hennebique, reinforced concrete was a system that permitted the advance beyond the

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130 Trélat wrote: "En résumé, l'acier et le ciment armé sont appelés à voir leurs applications se généraliser. Ils sont aptes à un mariage facile et commode avec d'autres matériaux comme la terre cuite et surtout le grès". Gaston Trélat, "Constructions en acier et en ciment armé", International Congress of Architects (see note 126), p. 173.

131 A. D., "Maison de rapport, avenue Perrichont", Le Béton Armé, vol. 11, no. 121, June 1908, pp. 67-73; P. Gallotti., "Le béton armé en architecture" and "Propriété de M. Danois", Le Béton Armé, vol. 11, no. 127, December 1908, pp. 163-165.

symmetrical frame toward new kinds of construction. Writing about the apartment building on rue Perrichont, the reviewer of Le Béton Armé quoted the engineer Charles Rabut:

> The flexibility of reinforced concrete suppresses any subordination in the parts of a building, the correlation between partition walls from one floor to the other, and between the ceilings on the same floor, the limitation of cantilevers, etc., enabling one to attempt everything without risk or expense. It must give birth to a new architecture, which shall be characterized by its extreme fantasy; the birth of this architecture will take time and a few men of some calibre.[132]

In a later project, the Buvette of the health spa of Miers (Lot) built in 1911, Richard offers an interesting example of hybridization between two apparently opposite conceptions of building materials (fig.29).[133] While the building's form seems to derive from the formal language developed by de Baudot, the reinforced concrete structure was erected following the technical pragmatism of the Hennebique firm. As Richard's work made clear, the Hennebique system was equally capable of achieving architectonic expression.

Richard's building experiments accorded with the Hennebique firm's conception of its relationship with architects. According to one of Hennebique's collaborators, the architect was to play the central role in the conception and execution of any project. The engineering office (*bureau d'études*) was viewed as merely a collaborator of the architect, who remained the coordinator of the various trades.[134] Though each system possessed inherent qualities and features, the architect was central in the definition of their architectural expression.

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132 A. D. (see note 131), pp. 68-70: "La souplesse du Béton armé supprimant toute subordination entre les parties du bâtiment, correspondance des murs d'un étage à l'autre, des plafonds dans un même étage, limitation des porte-à-faux, etc., permet de tout oser sans risques ni frais. Une nouvelle architecture doit donc naître, dont le caractère sera d'une extrême fantaisie; l'enfantement de cette révolution demande quelque temps et surtout quelques hommes d'une certaine envergure." (Rabut's remark was excerpted from his earlier communication at the Société pour l'avancement des sciences.)

133 On the project in Miers, see G. Delhumeau, "The buvette of the spa of Miers, 1910-11. Concrete without doctrine", Rassegna, no. 49, 1992, pp. 49-50.

134 Quesnel wrote: "Telle est toujours notre ligne de conduite vis à vis des architectes dont nous ne sommes que les collaborateurs. Il ne faut pas, en effet, méconnaître le rôle indispensable de l'architecte, du maître de l'oeuvre, homme compétent qui est le coordinateur nécessaire des divers corps de métiers". L. Quesnel, "De nos rapports avec les Architectes et les Ingénieurs spécialistes", Le Béton Armé, vol. 13, no. 140, January 1910, p. 3.

The independence of systems and forms was assessed by further developments in the institutionalization of reinforced concrete. In 1906, the publication of the *Circulaire ministérielle* devised by the Commission du ciment armé was to introduce important changes in the conception of the new material. One of the goals of this *Circulaire* was to systematize calculation methods and norms for the production of reinforced concrete, to bring the different systems under a single body of formulas and specifications. The theoretical position defended in the *Circulaire* was not unanimously accepted, triggering a debate among specialists highlighted by heated exchanges between Hennebique and Considère.[135] The government regulation did not put an end to the existence of the systems or the specialized building firms. But it nonetheless shifted attention from the commercial systems to the generic definition of reinforced concrete.

In an article first published in L'Architecture in 1908, the engineer Charles Rabut surveyed the categories of construction encompassed by reinforced concrete.[136] For Rabut, masonry and metal construction stood at opposite poles, and viewed as sub-categories of reinforced-concrete construction.[137] According to this framework, reinforced-concrete construction had become a generic term describing a great number of different constructions system, each covering a domain as vast as pure masonry or metal construction. The main defect of the new all-embracing system was its aesthetic appearance: it was a defect due to the newness of the resulting forms, and to the impossibility to express the "sheathed" metal.[138] Pursuing its thorough inquiry into

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135 On the *Circulaire ministérielle*, see Gwenaël Delhumeau, "Le béton armé et le Ministère des Travaux Publics: la circulaire de 1906", paper presented at the third meeting of the DRAST, Paris, METT, 8-9 November, 1993.

136 Charles Rabut, "Le béton armé, ses principes, ses ressources", L'Architecture, vol. 23, no. 18, 30 April 1910, pp. 155-156; no. 19, pp. 161-163. The article was first published in Annales des Ponts et Chaussées, vol. 4, July-August 1908.

137 Rabut wrote: "Le béton armé est donc beaucoup plus qu'un troisième procédé de construction venant simplement s'ajouter aux deux premiers: c'est un terme générique embrassant un nombre illimité de procédés de construction différents dont chacun peut avoir un domaine aussi vaste que celui de la maçonnerie ou de la charpente métallique pures." Rabut (see note 136), p. 156.

138 Rabut wrote: "Enfin, l'inconvenient réel qui se fera sentir le plus longtemps et qui cause, à mon avis, le plus de préjudice au développement du béton armé, du moins en Europe, c'est son infériorité esthétique, due surtout à la nouveauté des formes que comportent les nouveaux modes de construction, puis à l'inpossibilité de mettre en évidence les fers enrobés." Rabut (see note 136), p. 162.

modern materials, L'Architecture published a series of articles by J. Quost, who likewise conceived reinforced concrete as a building system.[139] The four categories he devised did not focus on the commercial systems, however, but on the various combinations of metal and cement or concrete. In doing so, Quost did not take into consideration the mutual adherence of the two basic materials, thus disregarding the fundamental technical specificity of the system.

For both Rabut and Quost, 'reinforced concrete' was a generic term which served to identify the many building systems based on the combination of a metal armature and a cement or concrete envelope. Before 1900, reinforced concrete was considered to be a type of metal construction. By around 1910 the situation had been radically reversed, for reinforced concrete had become a generic category that included metal construction itself.

4. The Frame and the Mask

In 1910, the critic Pascal Forthuny published a long review devoted to Parisian architecture of the first decade of the new century.[140] Among the changes brought about during this period, Forthuny pays special attention to the introduction of reinforced concrete in the construction of public and residential buildings, identifyng its major contribution with the production of low-income housing. Forthuny recognizes the influential role played by Anatole de Baudot and the contribution of Perret's 25bis rue Franklin, but his assessment betrays a general disappointment with the architecture of the

[139] J. Quost, "Des divers systèmes de béton de ciment armé dans la construction des bâtiments", L'Architecture, vol. 23, no. 31, 30 July 1910, pp. 261-263; no. 32, 6 August 1910, pp. 272-273; no.33, 13 August 1910, pp. 277-279; no. 34, 20 August 1910, pp. 285-287; no. 35, 27 August 1910, pp. 293-294.

[140] From the turn of the century onwards, Pascal Forthuny takes part in the architectural debate. From 1904 to 1906, he is the editor of La Construction Pratique, a short-lived periodical which challenged the positions of L'Architecture. In 1909, he is one of the editors of L'Architecture Moderne (1909-1922), a periodical which expressed less hostility towards the Ecole des Beaux-Arts. In 1913, he writes single-handedly the seven issues of a small review entitled Les Cahiers de l'Art Moderne, a periodical which played an important role in the controversy regarding the authorship of the Champs-Elysées theater. Pascal Forthuny, "Dix années d'architecture", Gazette des Beaux-Arts, vol. 3, 4th per., February 1910, pp. 191-210; May 1910, pp. 426-440.

decade. Pointing to the need to develop a new architectural language, Forthuny ends with a vivid description of the facade that would best embody *the style* of the time.[141] Three years after the publication of this article, it is the highly controversial project for the Théâtre des Champs-Elysées that was to give Forthuny -- and Parisian architectural circles -- both its modern facade and its first monumental architecture in reinforced concrete.

The construction of the Champs-Elysées theater was a major event in early twentieth-century French architecture.[142] From the time of its completion the theater focused critical attention, and its importance was emphasized by the debate on authorship that followed, the publication of critical reviews in most art and architectural periodicals, that opposed Henry Van de Velde and Auguste Perret.[143] Whether hailed or despised, the theater received great attention from architectural, artistic and cultural circles. For most observers, the modernity of the theater was unmistakable. This modernist quality was multifaceted, including the technical conception of the structure, the organization of the plan, the internal decoration, as well as the formal and decorative treatment of the exterior: the facade.

In this section, I argue that while the theater participates in the consecration of reinforced concrete as a building material suitable for monumental architecture, it also marks a turning point in the conception of Rationalism in French architecture. At the turn of the century, the Rationalists' advocacy of reinforced-concrete construction was

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[141] Forthuny wrote: "Où est-elle, en vérité, la façade de qui l'on puisse dire: "Elle fut étudiée par un homme libre, mais logique avec son temps, par un architecte qui voulut créer de l'architecture en conformité aux exigences de son milieu social comme le faisaient autrefois ses prédécesseurs en concevant lentement et tour à tour ce qui s'est cristallisé dans la série des styles. Or, cette façade, elle donne *le style* de l'heure où nous vivons. Voyez-la. Son équilibre de lignes, de lumières et d'ombres satisfait la raison, expliquant la forme de la vie contemporaine. Il y a là une certitude, un axiome de beauté mathématiquement tel qu'on en peut faire le point d'origine d'une esthétique. Qu'on l'étudie. Il en résultera une loi première d'où sortiront d'autres lois, comme le théorème engendre le théorème, à l'infini. Et, si l'on travaille logiquement sur cette donnée, dans quelques lustres le XXe siècle français aura son langage architectural". Forthuny, Gazette des Beaux-Arts (see note 140), p. 440.

[142] For a comprehensive account of the debate on the theater's modernity, see Jean-Claude Vigato, "Moderne, encore moderne, toujours moderne ! Les tribulations du théâtre des Champs-Elysées", Les Cahiers de la recherche architecturale, no. 12, 1982, pp. 24-39.

[143] On this question, see Bernard Marrey, "Qui est l'architecte du Théâtre des Champs-Elysées", Architecture d'Aujourd'hui, no. 174, July-August 1974, pp. 114-115.

grounded in the pursuit of the *vrai* in architecture. With Perret, Rationalist discourse had now subtly shifted from the search for the *vrai* to the expression of the *vraisemblable*. Taking over the discourse on rationalism and new materials, Perret proposed an alternative genealogy of, and path for reinforced-concrete architecture.

Auguste Perret and the Champs-Elysées theater

The project for the Théâtre des Champs-Elysées has a long and complex history. This history is all the more important for an understanding of the project since three architects were involved in the theater's design.[144] The first proposal for the site on the avenue Montaigne was by Roger Bouvard, an architect trained at the Ecole des Beaux-Arts. Bouvard's project was based on a metal skeleton masked by a traditional stone facade. Critical of Bouvard's decorative choices, the theater's Design Committee, headed by Gabriel Thomas, demanded that another architect be appointed to alter the aesthetic aspect of the project. Following the recommendation of the painter Maurice Denis, the Belgian architect Henry Van de Velde -- then head of the Kunstgewerbeschule in Weimar -- was appointed to the project in the summer of 1910.[145] The Design Committee also appointed the sculptor Antoine Bourdelle to work on the facade. Following early studies done in the fall of 1910, Van de Velde recommended that reinforced concrete replace steel as the structural framework of the theater, a suggestion that was to have major consequences for the course of the project. Van de Velde's suggestion was made at a time the new system was increasingly considered as a substitute for metal-frame construction.[146] The search for building contractors specialized in reinforced-concrete construction led to the engagement of the Perret Brothers firm. First introduced to the project in January 1911,

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[144] For a thorough discussion of the project's history, see Claude Loupiac, "Le ballet des architectes", 1913: Le Théâtre des Champs-Elysées, Paris, Réunion des Musées Nationaux, 1987, pp. 22-52.

[145] See Léon Ploegaerts, Pierre Puttemans, L'oeuvre architecturale de Henry Van de Velde, Bruxelles-Québec, Atelier Vokaer-Presses de l'Université Laval, 1987.

[146] L. Quesnel, "Correspondance. Lettre ouverte à Henri Lavedan, de l'Académie Française", Le Béton Armé, vol. 16, no. 179, April 1913, p. 52.

the Perrets were hired in March. Hired as specialists in reinforced-concrete construction, they were responsible only for the adaptation of the original iron structure to the new material. But they were soon to declare that the planned structure could not be done in concrete, and began to redesign the entire structural skeleton. Their suggested modifications went beyond the structure, however, and they proposed changes to the interior planning and the facade of the theater. Auguste Perret's growing ascendency over the project triggered a confrontation with Van de Velde, which finally led to his resignation in the summer of 1911. After Van de Velde's resignation, the conception and execution of the entire project was entrusted to Auguste Perret and the Perret Brothers firm, under the technical supervision of the engineer Eugène Milon and the aesthetic guidance of the Design Committee. Perret made a few changes to the organization of the plan: the entrance, the concert hall, etc. He also intervened in the decoration of the interior. The painted decoration was done in collaboration with a group of artists which included the painter Maurice Denis. Finally, he completed the design of the facade in close collaboration with the sculptor Antoine Bourdelle.

The Perrets' gradual takeover of the project was a consequence of the unique organization of their firm. On the rue Franklin project, the Perrets had been compelled to hire a building contractor specialized in reinforced-concrete construction. By the time of the theater project, however, the Perrets had themselves become specialists in reinforced concrete. The change occurred around 1906 when the Perret brothers turned the family enterprise into a building firm that specialized in reinforced concrete, the "Perret Frères - Entreprise Générale de Travaux Publics et Particuliers - Béton armé".[147] This change coincided with the promulgation of the *Circulaire ministérielle* that sought to normalize reinforced-concrete construction. The creation of this type of specialized firm was welcomed by many specialists, such as the engineer Fritz von Emperger -- a central figure in reinforced-concrete construction in Europe -- who was highly critical of the separation

[147] On this question, see Joseph Abram, "An Unusual Organization of Production: the building firm of the Perret Brothers, 1897-1954", Construction History, vol. 3, 1987, pp. 75-93.

of design from execution brought about by the system of *concessionaires.*[148] The new organization set up by the Perrets ran counter to the rules of professional conduct defined by the code Guadet.[149] But it gave them the means to bridge the gap between design and execution.

Their first experience as a specialized firm was the design and construction of the garage rue de Ponthieu for the Société Ponthieu-Automobiles. While the first studies were done in June 1906, the construction of the garage dated from 1907.[150] The structural system of the garage -- post and beams with slabs -- largely derived from the Hennebique system. The garage project was executed at the same time as the construction of the Hôtel Carnot designed by Paul Guadet (1906-08). Their second major undertaking was the consolidation of the Oran cathedral (Algeria) designed by Albert Ballu in 1900. The cathedral was originally to be built in reinforced brick with the Cottancin system. The Perrets took over the execution of the project around 1908, after the crypt had been built by Cottancin, with the task of redesigning the internal structure of nave and choir and the conception of a system of light concrete-block infill called *claustra.* By the early 1910s, the firm of the Perret brothers was able to ensure continuity between the conception and execution of architectural works. In such an organization, Auguste Perret could act both as architect and reinforced-concrete specialist. It gave him the technical mastery that Rationalist architects had always sought. It also gave him the power to justify his aesthetic choices on the basis of technical determinations.

Auguste Perret's involvement in the theater project was linked to Van de Velde's recommandation to substitute Bouvard's steel construction with reinforced concrete. By

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148 Fritz von Emperger, "The prevention of failures in reinforced concrete structures", Concrete and Constructional Engineering, vol. 4, no. 5, October 1909, p. 312; see also: F. von Emperger in Bericht über den VIII. Internationalen Architekten -Kongress,Wien, 1908.

149 Adopted at the 1895 Congrès des Architectes Français, the Code Guadet defined the duties of professional architects towards themselves, their colleagues, their clients, and the entrepreneurs, following the logic of liberal professions. Julien Guadet, Eléments et théorie de l'Architecture, tome "Additions", Paris, Librairie de la Construction moderne, 1901-04, pp. 572-575.

150 The completion of the garage has often been incorrectly dated to 1905 based on the 1926 publication of Paul Jamot's article "1905. date décisive pour l'architecture du béton armé" in l'Art Vivant.

the 1910s, the steel structures had become a logical alternative to stone in the construction of major urban buildings. By that time however, metal frameworks were usually hidden within walls, covered with stone to give the construction an appropriate urban facade. Accepting Van de Velde's suggestion, the Design Committee solicited submissions from contractors in reinforced-concrete construction. The Perret Brothers' winning submission apparently allowed for an economy of 400 000 Francs, giving some evidence that the decision for reinforced concrete was primarily motivated by cost.[151] Beyond the structural adaptation they were hired for, the Perrets' modifications reveal implications of reinforced concrete that were other than structural. Though the facade was originally conceived as a heavy masonry wall, the Perrets now proposed a lighter combination of marble revetment over concrete frame.

The debate that followed the completion of the theater was intense. For some critics, the theater embodied the synthesis of architectural Rationalism and reinforced-concrete construction. It was the position sustained by Paul Guadet in L'Architecte.[152] According to him, the theater was a major step in the evolution of the art of architecture because "the architect dared to frankly express in a monument the use of a new mode of construction: reinforced concrete."[153] For Guadet, that expression of the framework was key to the conception and interpretation of the project, an argument he sustained by reproducing two drawings of the theater's structure done after the completion of the building.[154] The first illustration (dated 1913) was a cut-away axonometric view of the reinforced-concrete skeleton (fig.30). Though representing the concrete framework, the illustration is an architectural drawing which depicts the frame as it is conceived by an architect.[155] The second illustration (dated 7 October 1913 and signed by Auguste and Gustave Perret) was

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[151] This argument is sustained, among others, by Ploegaerts and Puttemans (see note 145), p. 107.
[152] Paul Guadet, "Le Théâtre des Champs-Elysées", L'Architecte, vol. 8, October 1913, pp. 73-80; November 1913, pp. 81-87.
[153] Guadet (see note 152), p. 73.
[154] Guadet (see note 152), p. 75.
[155] For a discussion on the structural frame as an idea in European architecture, see Colin Rowe, "Chicago Frame", The Mathematic of the Ideal Villa and Other Essays, Cambridge, MIT Press, 1976.

a perspective drawing illustrating the concept of the structure (fig.31). They helped underscore the structural Rationalism of Auguste Perret's architecture.

The controversy over the authorship of the theater offered Perret an ideal occasion to present and defend his architectural position, which he did in a letter to the critic Pascal Forthuny published in Les Cahiers de l'Art Moderne.[156] Perret formulated an interpretation of the theater which focused on the impact of the reinforced-concrete structure on the overall design. He argued that the composition of the plan and the facade of the theater derived from the configuration of the frame of the main hall: four pairs of columns.[157] For Perret, the two giant pylons of the facade, forming a portico, reflected the disposition of the structural frame. The form of the internal columns was also justified by a constructional argument. Perret argued that the adoption of the round shape for the construction of reinforced concrete posts was the most logical from both a structural and technical point of view.[158] Yet, except for the columns of the entrance and main hall, the concrete posts were constructed out of square formworks. Moreover, most of the round columns (like the ones in the *promenoir*) were in fact square concrete columns that were given a round shape by means of thick coat of plaster (fig.32).[159] Perret further emphasized the importance of the structural framework through a photographic montage presenting the facades of three of his works: the 25bis rue Franklin, the garage rue de Ponthieu, and the theater (fig.33).[160] Presented to show a continuity in the architect's

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156 Letter from A. & G. Perret, in Pascal Forthuny, "Le Théâtre des Champs-Elysées", Les Cahiers de l'Art Moderne, no. 7, 30 October 1913, pp. 6-14.

157 Perret wrote: "Passons à l'ensemble de notre plan; à ces quatre groupes de deux points est liée toute la composition; c'est sur eux que s'alignent tous les poteaux de la construction, poteaux qui aboutissent en façade aux deux pylones de notre grand portique." In Forthuny (see note 156), p. 7.

158 Perret wrote: "Ignorant les ressources multiples qu'offre le béton armé, vous jugez sans bienveillance nos piliers ronds. Nous nous bornerons à vous faire remarquer que c'est là la section idéale d'une pièce chargée debout. On emploie pour leur exécution un coffrage circulaire qui sert à chaque étage, ou un procédé de cintrage avec de la tôle. Nous nous sommes arrêtés à ce parti parce qu'il différencie les pièces chargées debout des nervures ci-dessus qui, elles travaillent surtout à la flexion." In Forthuny (see note 156), p. 13.

159 See especially the photographic views of the rough concrete posts and the completed *promenoir* in Guadet (see note 152), p. 85.

160 Forthuny (see note 156), figure V.

work, the montage emphasized the frame, for the continuity lay in the "rising lines of the reinforced-concrete structures."

The facade as mask

After the inauguration of the theater in May 1913, most reviewers commented on the design of the facade, and the source of that design proved a major point of contention. For many critics, Perret's inspiration was rooted in aesthetic models that were foreign to the French tradition. Reviewing the theater in L'Architecture, the critic Maurice Brincourt wrote: "We are told that the use of new materials must give birth to a style appropriate to these materials and new methods of construction. And as evidence of this theory, one goes as far as Greece to find the style appropriate for the clothing of reinforced cement."[161] Brincourt warned of the danger of a talentless imitation that could drive French architecture into a foreign style.[162] The editor of L'Art de France held a similar view. For Emmanuel de Thubert, the false simplicity of the facade was unacceptable. Rejecting all claims regarding its revolutionary character or newness, he scorned the facade as being a mere Greek disguise.[163] That influence was effectively confirmed by Louis Gellusseau, the reinforced-concrete engineer working for the Perrets. Offering his own interpretation of the program, Gellusseau wrote that the project drew inspiration from the purity of antique monuments, in an attempt to adapt the simplicity of classical forms to the exigencies of our century.[164]

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161 Maurice Brincourt, "Le nouveau théâtre des Champs-Elysées", L'Architecture, vol. 26, no. 20, 17 May 1913, p. 162: "On nous dit que l'emploi de matériaux nouveaux doit marquer l'avènement d'un style approprié à ces matériaux et à de nouvelles méthodes de construction. Et à l'appui de cette théorie, on va chercher jusqu'en Grèce le style supposé devoir habiller logiquement du ciment armé."

162 Brincourt (see note 161), p. 164.

163 De Thubert wrote: "Sous prétexte de simplicité, les architectes ont élevé une façade plate et carrée qui est insoutenable. Cela du moins est-il révolutionnaire ? Non. Nouveau ? Pas même. C'est encore du grec travesti". Emmanuel de Thubert, "Le Théâtre des Champs-Elysées", L'Art de France, vol. 1, no. 1, 15 June 1913, p. 80.

164 Gellusseau wrote: "Le programme imposé était le suivant: s'inspirer de la pureté d'un monument antique pour en adapter les formes logiques, la noblesse de style et la simpicité classique aux nécessités de notre siècle, en se servant de moyens et de matériaux modernes." Louis Gellusseau, "Constructions civiles: le théâtre des Champs-Elysées à Paris", Le Génie Civil, vol. 33, no. 1608, 5 April 1913, p. 441.

Critics were right to point out the relation between the theater's facade and current artistic trends. By the end of the decade, critics had already begun to note a perceptible trend toward the simple and the classical in architecture.[165] Reviewing the 1910 Brussels International Exhibition in the Gazette des Beaux-Arts, the art critic Roger Marx annouced that "Already the concern for decoration withdraws before the authority of form".[166] Marx perceived a tendency toward a beauty defined by the rhythm of lines, an equilibrium of masses, and a harmonious rapport of solids and voids, a beauty 'more serious and more Greek', which accorded perfectly with modern techniques of construction.[167]

In a 1912 article published in L'Architecture, André Véra called for "order and clarity of form".[168] He argued that the recent interest in the treatment of surfaces in the creation of sensations was to be replaced by the search for architectural qualities through composition. This search for a new architecture was to focus on form rather than color and flat planes rather than curves, and to reduce sculpture to low-relief wherever used. Véra's description offered a striking prefiguration of the facade of the Champs-Elysées theater.

Yet when the theater was completed, this new attitude towards composition and form came to be negatively identified with a German aesthetic. References to Greek sources were associated with the current German taste for abstract classicism. The critic of L'Illustration lamented the fact that Perret was too much inspired by the art of Munich and Dresden, an art foreign to the French tradition.[169] Many critics viewed the theater as

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165 This new trend in French architecture is discussed in Clausen (see note 48), p. 180.

166 Roger Marx, "L'Art social et l'Exposition de Bruxelles", Gazette des Beaux-Arts, vol. 4, June 1910, p. 490: "Déjà le souci du décor s'efface devant l'autorité de la forme."

167 Marx wrote: "Que sera la beauté de demain, du moins dans les ouvrages que régit l'architecture, l'art social par excellence ? Son secret résidera peut-être dans le rythme des lignes, dans l'équilibre des proportions et des masses. Ce sera une beauté plus grave et plus grecque. Le principe s'en accorde pleinement avec les possibilités de réalisation des techniques modernes...." Marx (see note 166), p. 490.

168 André Véra, "La Nouvelle Architecture", L'Architecture, September 1912, pp. 65-67; October-December 1912, pp. 73-75.

169 He wrote: "Peut être regrettera-t-on seulement que celui-ci se soit trop directement inspiré de l'art mis en honneur à Munich et à Dresde: transplanté à Paris, il nous apparaît d'une solennité un peu sèche, délibérément indigente, et par là s'écartant de toute tradition française". In [Anonymous], "L'inauguration du Théâtre des Champs-Elysées", L'Illustration, vol. 71, no. 3658, 5 April 1913, p. 302.

a manifestation of the influence of Germanic art, an association which was undoubtedly due to the recent successes of the German decorative arts on the Parisian scene.[170]

In his review, the art critic Paul Jamot approved Perret's decision to clothe the facade with a rich revetment.[171] Making a veiled reference to the Rationalist school, Jamot explains that their theoreticians would have condemned this use of revetment, for "they proclaimed that in a building honestly constructed, the materials of construction had to be exposed to the eye."[172] Yet Jamot argued that the doctrine, legitimate for monuments based on traditional construction, was not appropriate for building processes based in modern materials. He stated that in the noble parts of the building, concrete and bricks had to be concealed under a richer costume. Defending the use of a rich cladding material, Jamot wrote:

> When an architect lays a marble garment on a body of iron and concrete, he proceeds like the painter who has carefully drawn a nude figure before dressing it up. The only important point is that this finery be a garment and not a mask: better than a modern costume, and almost as good as antique drapery, it adapts itself to the forms it decorates and envelops.[173]

The architect Paul Guadet shared the position advanced by Jamot. In his review of the theater's facade design, Guadet recalls the theoretical work of his father Julien Guadet and of the Viennese architect Otto Wagner, in whose writings he distinguishes a shared rationalism.[174] Paul Guadet's reference to the work of Wagner is not surprising, for in

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[170] On the exhibition of Munich designers at the 1910 Salon d'Automne, see Nancy Troy (see note 10).
[171] Paul Jamot, "Le Théâtre des Champs-Elysées", Gazette des Beaux-Arts, vol. 55, no. 669, April 1913, pp. 261-294.
[172] Jamot wrote: "Les théoriciens auraient autrefois condamné comme une hérésie cet emploi des revêtements. Ils proclamaient que, dans un ouvrage sainement construit, la façade devait exposer à découvert la matière de la construction." Jamot (see note 171), pp. 271-272.
[173] Jamot (see note 172), p. 273: "Lorsque l'architecte dispose un vêtement de marbre sur un corps de fer et de béton, il procède comme le peintre qui a dessiné avec soin une figure nue avant de l'habiller. Il importe seulement que cette parure soit un vêtement et non un masque: mieux que le costume moderne, et presque aussi bien que la draperie antique, elle s'adapte aux formes qu'elle orne et enveloppe."
[174] Guadet wrote: "Quelle similitude de pensée sous une expression différente ! Quoi de plus juste que ces maximes ? quoi d'étonnant à ce que toute la pléiade d'artistes formée directement ou indirectement à l'école de ces maitres aboutisse à des productions dont le rationalisme les rapproche du même idéal, si le point de départ n'est pas le même ?". Guadet (see note 152), p. 86.

1906 he had written an important review of his work published in L'Architecte.[175] There Guadet presented Wagner's work in conjunction with his theoretical treatise *Moderne Architektur*, first published in 1896. Wagner's belief in the causal relationship between architectural aesthetics and construction is underscored by Guadet: "Architecture must always derive its aesthetic from construction."[176] Guadet gives a positive review of Wagner's decorative treatment of the Majolikahaus (1898) and the Postsparkasse (1904-06) in Vienna. For Wagner, the facade was conceived as a mask, expressive of the technical and symbolic meaning of new materials and construction systems.[177] Guadet praised Wagner's treatment of reinforced concrete, adding that "this material can only be decorated with a revetment, which, moreover, constitutes a sort of mantel protecting it from bad weather".[178] In fact, Guadet's treatment of the facade of the Hôtel Carnot built in 1908 on the avenue Elysée-Reclus can be linked securely to Wagner's conception of the architectural mask (fig.34).

Paul Guadet's Wagnerian reading of the theater facade is revealing. Discussing Perret's treatment of the marble revetment, Guadet stressed a difference from Wagner's method. For Guadet, there was no need to use bronze bolts to reveal that the marble was only a dressing, as in the case of the Vienna Postsparkasse. He praised instead the method adopted by Perret, where the joints were vertical rather than horizontal as in a normal masonry course.[179] For Guadet, such a similarity in the treatment of a modern facade was not surprising, as it derived in part from the use of modern materials: "It is

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175 P. Guadet, "L'oeuvre du professeur Otto Wagner", L'Architecte, vol. 1, 15 December 1906, pp. 89-93.

176 Guadet (see note 175), p. 89: "L'architecture doit toujours tirer son esthétique de la construction".

177 On Wagner's work, see Harry F. Mallgrave (ed.), Otto Wagner: Reflections on the Raiement of Modernity, Santa Monica, The Getty Center for the History of Art and the Humanities, 1993.

178 Guadet wrote: "Ajoutons pour complètement justifier ces modes de construction, que ce sont bâtiments construits entièrement en béton armé, et l'on sait que ce matériau ne peut se décorer que par revêtements, qui, d'ailleurs, lui constitue une sorte de manteau qui le protège contre les intempéries. C'est du moins la seule façon rationnelle de le décorer; car que signifierait la traduction, le moulage, pour ainsi dire, d'une façade de pierre transposée en ciment". Guadet (see note 175), p. 90.

179 Guadet wrote: "La subtilité de l'observateur ne serait-elle pas assez aiguisée pour lui faire remarquer que les joints d'appareils, au lieu de se correspondre horizontalement comme pour des assises, se suivent verticalement." Guadet (see note 152), p. 78-79.

obvious that, with the uniformization of construction processes and materials employed in architecture as in many other branches of human activity, the regional distinctions of the past can only disappear."[180]

One of Perret's drawings, which shows the construction process of the marble revetment, offers further evidence of the facade's conception in terms of dressing (fig.35).[181] Depicting the mode of construction of the marble slabs, the drawings emphasize the verticality of the joints, in contradiction to the horizontal joints of traditional stone dressing. Perret's adoption of a method similar to the architectural practice of dressing is indicative of the relative dissociation between the frame and the facade. The history of the facade design is further evidence of the architect's conceptual separation between the frame and its external expression. The design of the facade proved to be one of the most debated aspects of the project. From the outset, the design process was complicated by the requirements of the Design Committee. Following the rejection of Bouvard's facade and the appointment of Van de Velde, the process turned into a conflict between the competing projects of Van de Velde and Perret (fig.36). This process continued as a problematic collaboration between Perret and Bourdelle. Recent research has shown the important role played by Bourdelle in the later stages of the facade design.[182] Since many drawings for the facade are undated, it is difficult to establish the exact chronology of the design process, and assess the exact contribution of each designer. Letters from Bourdelle to Perret regarding the size of the projecting cornice, however, are revealing of the difficulties that arose during the design "dialogue", and proof of the fact that the facade is mainly the result of design compromises. A few dated drawings provide sufficient evidence that Perret's fundamental contribution lay in the proposal of a light facade with a marble revetment. In the executed project, the marble

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[180] Guadet (see note 152), p. 86: "Il est évident aussi que, avec l'uniformisation actuelle des procédés de construction et des matériaux employés dans l'architecture comme dans toutes les branches de l'activité humaine, les distinction régionales du passé ne peuvent que disparaître."
[181] The drawing was published in Guadet (see note 152), p. 79, figs. 68 and 69.
[182] See Denise Basdevant, Bourdelle et le Théâtre des Champs-Elysées, Paris, 1982; Loupiac (see note 144).

facade offers only a symbolic *representation* of the reinforced-concrete frame. In fact, the many studies of the theater facade are telling of the dissociation between the conception of the structural frame and the search for an appropriate architectural expression. The facade of the theater did not evolve from the structural frame; it was conceived as an architectural mask.

The idea of the facade as a mask is implicit in Charles-Edouard Jeanneret's reading of the theater. In an article on the "renewal of architecture" published in L'Oeuvre, Jeanneret -- who had worked at Perret's office -- wrote: "One cannot and should not erect the same stone face on the reinforced concrete *carcasse* of the theater as on the imposing and massive piers of the Invalides. It would be to maintain, against common sense, an aesthetic that general progress compels us to modify."[183] Jeanneret's reference to the Hôtel des Invalides derived from Perret's own mention of the building in his letter to Forthuny published in 1913.[184] Jeanneret's understanding of the facade is clear: without designing, Perret nonetheless gave the building a marble face: a modern mask.

Perret's conception can be further assessed by looking at a little known (and unrealized) project for a concert hall. Shortly after the completion of the Champs-Elysées theater, Perret was engaged to design a concert hall for the Société Royale d'Harmonie in Antwerp (Belgium). The first studies were probably done at the end of 1913, and the presentation drawings were completed early in 1914 (fig.37).[185] Perret intended to use the same building method: a reinforced concrete frame with brick infill. The main facade of the hall was to be clothed with a rich material, such as marble, or in stucco imitating stone, while the back facades were to be left bare. This project offers further confirmation

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183 Charles-Edouard Jeanneret, "Le renouveau de l'architecture", L'Oeuvre, no. 2, 1914. p. 33: "Sur la carcasse de béton armé du Théâtre vous ne pouvez ni ne devez élever le même visage de pierre que sur les piles formidables et massives des Invalides. Ce serait maintenir, contre le bon sens, une esthétique que le progrès général ordonne de modifier."

184 In Forthuny (see note 156), p. 6.

185 Studies and presentation drawings of the project are preserved in the Perret Archive (535 AP 8/3).

of Perret's sense of the need to design a monumental mask for the reinforced-concrete frame.[186]

This project also points to the status of revetment materials. Commenting on the facade of the Champs-Elysées theater, Paul Guadet wrote: "The richness necessary for such a monument is obtained by the use of the rich materials available to architecture: marbles and gold."[187] In a text entitled "Le Style sans ornements" found in one of his notebooks -- a text which can be dated around the mid 1910s -- Perret wrote: "bare -- the garage (Ponthieu); revested with ceramic -- rue Franklin; revested with marble -- the Champs-Elysées theater".[188] These notes and comments underscore that on the eve of the First World War, reinforced-concrete construction still required the use of an appropriate revetment, revealing that the hierarchy among the different revetment materials was linked with an assessment of building function that clearly distinguished between utilitarian and monumental architecture.

These comments also reveal a shift in the ornamentation of concrete construction embodied in the Champs-Elysées theater. At the turn of the century, the treatment of the new material was associated with the Byzantine, Persian, and/or Islamic modes of decoration. A decade later, reinforced-concrete construction came to be associated with a decorative practice akin to Roman *placage* (cladding). This new approach emphasized the dissociation between the industrial texture of the concrete surfaces and the architectural expression of the concrete frames.

Perret's contribution to reinforced-concrete architecture has been commonly associated with the development of the frame, and the theater has been viewed as a major

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186 Mayer wrote: "De décoration surajoutée, point. La seule ornementation prévue est tirée de la construction qui est en béton armé avec revêtement de marbre ou de stuc-pierre loyalement employé. (...) Le remplissage de cette construction est envisagé en double paroi de brique avec revêtement". Marcel Mayer, "Auguste Perret: l'homme, l'oeuvre, le novateur", unpublished manuscript [ca. 1926], p. 91 (Fonds Perret, 535 AP 358).

187 Guadet (see note 153), p. 78: "La richesse nécessaire à un tel monument est obtenue par l'emploi de matériaux par eux-mêmes les plus riches dont l'architecte puisse disposer: la marbre et l'or."

188 Auguste Perret, "Le Style sans ornements", manuscript notes, n.d. [c. 1914] (Fonds Perret, 535 AP 329).

achievement in this direction. Yet it is essential to point out that in this project the frame was not used to generate any new spatial organization. Here the frame was adapted to fulfill the needs of a conventional theater plan.[189] According to Claude Loupiac, the original project was conceived as an innovative theater plan built within a rather traditional building envelope, while the final project, quite the contrary, resulted in a fairly conventional theater plan built within a modern building envelope. "The modernity of the project", writes Loupiac, "has thus shifted from the interior to the exterior, from essence to appearance."[190] It is a modernity embodied in the duality between the frame and the mask.

The birth of a new genealogy

By the early 1910s, interest in reinforced concrete as a modern material began to spread beyond architectural circles. A conspicuous manifestation of this interest was the conception of the Maison Cubiste fashioned by Raymond Duchamp-Villon for the 1912 Salon d'Automne Exhibition (fig.38). The project was initiated by the decorator André Mare, who asked Duchamp-Villon to design a facade that would unify an interior decorative scheme to be exhibited at the Salon. The facade was apparently conceived as an application of reinforced-concrete construction. According to a contemporary reviewer, Duchamp-Villon said at the time that the *maison* was suggested in part by new developments in concrete and steel.[191] The plaster model exhibited at the Salon d'Automne shows that the reinforced concrete was treated as a molded material, emphasizing the continuity of the wall surface and the ornaments.

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[189] Discussing the role of the reinforced-concrete structure in the definition of the spatial configuration of the theater, Simonnet writes: "L'ossature en béton armé résoud cette combinaison programmatique, elle ne l'invente pas". Cyrille Simonnet, "Matériau et Architecture. Le béton armé: origine, invention, esthétique", vol. 3, doctoral dissertation, Paris, EHESS, January 1994, p. 346.

[190] Loupiac (see note 144), p. 50: "La modernité est ainsi passée de l'intérieur à l'extérieur, de l'essence aux apparences."

[191] William C. Agee, Raymond Duchamp-Villon 1876-1918, New York, Walker and Co., 1967, p. 67.

Duchamp-Villon was a member of the Artistes de Passy group founded in July 1912, of which Auguste, Gustave, and Claude Perret were also members.[192] At a reunion of the group in November 1913, Duchamp-Villon held a conference entitled "L'Architecture et le fer", a celebration of the aesthetic of the Eiffel Tower. For the artists at Puteaux, especially Duchamp-Villon and Delaunay, the Eiffel Tower was a symbol of the dynamism and beauty of the modern urban world. Duchamp-Villon grounded his discussion on the paradigmatic works of iron architecture: the Gallery of Machines, the works of Henri Labrouste and Victor Baltard.[193] He also pointed to the transitory nature of iron architecture, and the future of reinforced concrete: "We all know the few examples of liberated architecture which Paris owes to it [iron], and we need but dream a bit to foresee the future of reinforced concrete, combined with stone, marble or even wooden decoration."[194]

Duchamp-Villon's reference to nineteenth-century iron architecture, and to the bright future of reinforced-concrete architecture, was most certainly indebted to Auguste Perret. The same is probably true of the discourse held by Sébastien Voirol in the pages of Montjoie!, a new artistic periodical of cubist and futurist leanings.[195] Voirol -- a member of the Artistes de Passy group and Perret's brother in law -- wrote that while nineteenth-century architecture was an architecture of iron (giving as examples the Bibliothèque Nationale, the Halles centrales, the Galerie des Machines), twentieth-century architecture was one of reinforced concrete.[196] For Voirol, it was the architecture of the Perret brothers that best embodies this historical trend: "They are the ones who,

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[192] G. Fanelli, R. Gargiani, Auguste Perret, Bari, Laterza, 1990, p. 40.

[193] The text of the conference was later published in Henri-Martin Barzun's periodical Poème et Drame. R. Duchamp-Villon, "L'architecture et le fer", Poème et Drame, no. 7, January-March 1914, pp. 22-29.

[194] Duchamp-Villon, quoted in Agee (see note 191), p. 116.

[195] Sébastien Voirol, "Où en sont les architectes ?", Montjoie!, no. 2, April-June 1914, pp. 12-13.

[196] Voirol wrote: "Le siècle dernier fut celui de la construction en fer; nous lui devons la Bibliothèque Nationale, les halles, le Palais des machines, etc., auquels sont attachés les noms de Labrouste, Baltard, Dutert et Formigé. Le XXe siècle est celui du béton armé. Ce n'est pas ici le lieu de démontrer en quoi ce matériau est supérieur à tous autres connus, ni d'expliquer comment, à cause de cela, il fut décrié par tous les architectes ignorant le métier, par les brasseurs d'entreprises, par la foule et par les néfastes élites académiques". Voirol (see note 195), pp. 12-13.

thanks to their profound knowledge of reinforced-concrete construction, have until now provided the most thorough idea of its nature".[197]

Duchamp-Villon's and Voirol's architectural genealogy was clearly indebted to Perret's conceptions. But Perret himself was in turn probably indebted to Lucien Magne, his former history professor at the Ecole des Beaux-Arts. During the 1890s, Magne began to emphasize the central role played by iron in nineteenth-century French architecture, insisting on the key contribution of Labrouste's Bibliothèque St-Geneviève, Baltard's Halles centrales, and Dutert's Galerie des Machines.[198] At the turn of the century, Magne increasingly focused on the study of the decorative use of metal in architecture.[199]

Magne's position could be traced back to his early review of nineteenth-century French architecture. In L'architecture française du siècle of 1889, Magne claimed that Rationalism, "that is to say, the appropriation of decorative forms by construction itself, is tending to become the principle of all modern composition".[200] In French architectural circles, Magne was apparently one of the first to attempt a synthesis of classical and rationalist principles. Borrowing from Magne, Perret developed an interpretation of progressive architecture grounded on a genealogy of modern materials.

Perret's conception of architectural developments could well appear to derive from the position defended during the 1900s by the Rationalist school and Anatole de Baudot. They too had associated nineteenth-century developments with iron architecture. They too had claimed that reinforced cement (or concrete) was the material of twentieth-century

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[197] Voirol (see note 196), p. 12: "Ce sont eux, en effet, qui, grâce à leur connaissance approfondie de la construction en béton, ont su donner de celle-ci l'idée jusqu'à présent la plus complète."

[198] Lucien Magne, "L'architecture moderne", Art et Décoration, tome 3, 1898, pp. 45-53, 73-80; and in Frantz Jourdain et al., "Les conquêtes de la science - L'architecture", L'Architecture, vol. 13, 1900, pp. 377-78.

[199] Lucien Magne was appointed professor of history at the Ecole nationale des Beaux-Arts in 1891. He was named professor of applied arts at the Conservatoire National des Arts et Métiers in 1899. Magne's teaching at the Conservatoire focused on the decorative use of iron. See Lucien Magne, "Le fer dans l'art moderne", Revue des Arts Décoratifs, vol. 20, 1900, pp. 351-358; "La décoration du fer", L'Art décoratif, vol. 5, 1900, pp. 122-133; "L'art appliqué aux métiers. Application de l'art au travail des métaux", Revue des Arts Décoratifs, vol. 22, 1902.

[200] Lucien Magne, L'architecture française du siècle, Paris, Firmin-Didot, 1889, pp. 88, 102.

architecture. In 1913, Pascal Forthuny could still associate the search for an aesthetic of reinforced-concrete architecture with the followers of Viollet-le-Duc.[201]

Yet on the eve of the First World War, the aesthetic of reinforced-concrete architecture was to be increasingly associated with the works of Auguste Perret. The shift from de Baudot's rationalism to Perret's structuralism is crucial. It is a shift from the concern for the unity of material to the separation between frame and infill, a shift in the dialectical relation between the structural skeleton and the building plan, and a shift from the treatment of the cement surfaces by means of inlaid decoration to the cladding or clothing of the structural frame. This new conception of the material, best embodied in the Champs-Elysées theater, was soon to be questioned by the effects of the war.

[201] Forthuny wrote: "Dans les années dix, les modernistes les plus lucides avaient compris que l'Art Nouveau, le modern style ne répondraient pas à leur attente qu'ils se fussent mis à l'école de Viollet-le-Duc et qu'ils eussent mis alors tous leurs espoirs de renouveau dans une esthétique du ciment armé ou qu'ils fussent en quête d'une architecture plus simple, épuisés par les excès décoratifs du naturalisme". Pascal Forthuny, "Les hontes de l'architecture. Architecture ? Pourritures !", Les Cahiers de l'Art Moderne, no. 2, 1913.

CHAPTER III

BETWEEN CONSTRUCTION AND PRODUCTION:
Reinforced concrete and architectural reconstruction (1914-1923)

By the eve of the first World War, reinforced concrete had come to be recognized as a suitable material for monumental architecture, due in no small part to the critical reception of the Théâtre des Champs-Elysées. The destruction in Flanders and northern France during the Great War brought about a shift in its progress. By the early 1920s, many architects were actively working out designs and patents destined to address the problems of the reconstruction. The search for the rational use of building materials now focused on experiment rather than expression. Architectural experimentation was not unknown before 1914, but the intense production carried out during the war and the reconstruction that followed had a direct impact on the discipline and practice of architecture. Industrial architecture and industrial organization became new models of reference, challenging the accepted referents of the Academic traditions.

By the early 1920s, the architects Auguste Perret and Le Corbusier had become the two main proponents of the use of modern materials in modern architecture. Inaugurated in 1923, Perret's church at Le Raincy was hailed as a major achievement in reinforced-concrete architecture. Le Corbusier's Vers une architecture published the same year, was hailed as a manifesto of modern architecture. Both Perret and Le Corbusier viewed reinforced concrete as a unique common denominator of architecture's renewal. Both Perret and Le Corbusier proposed a critical interpretation of the rapport between materials, technology, and architecture.

As for many other architects, the thinking and practice of Auguste Perret and Le Corbusier had been influenced by the new conditions of production and practice brought about by the war and the reconstruction. In their reassessment of the relations between architecture and building, Perret emphasized the experience of construction, while Le

Corbusier stressed the study of production. While Perret attempted to transform Academic categories, Le Corbusier was to challenge their validity. In this chapter, I argue that by the early 1920s Perret and Le Corbusier had shifted the operative ground of Rationalist theory. By that time, the advocacy of reinforced concrete was to epitomize two different approaches to the Rationalist equation between materials and architecture.

1. The Reconstruction and the Question of Materials

The first few months of the war saw the destruction of whole regions in Flanders and the north of France. The prevailing belief that the war would be short was shared by many members of the architectural profession. As early as 1915, proposals for the rebuilding of the destroyed regions began to appear.[1] From then on, the question of the reconstruction of the devastated areas was inscribed on the architectural agenda.[2]

An early attempt to address the issues that reconstruction raised was the exhibition entitled *La Cité reconstituée* presented in the Tuileries garden in 1916, organized conjointly by the major architectural and Beaux-Arts associations.[3] The program of the exhibition included the whole field of architecture, ranging from the small rural house to the plans for the expansion of large cities. This exhibition was important in that it highlighted an important construction problem: the short-term need for temporary housing opposed to the long-term need of permanent reconstruction. In terms of architecture, the exhibition was mostly devoted to the presentation of temporary housing: various types of

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[1] See for example: Alfred Agache, J.-M. Auburtin, Edouard Redont, Comment reconstruire nos cités détruites, Paris, Armand Colin, 1915; Jacques Hermant, La reconstruction des villes détruites, 1916.

[2] For an overview of the architectural debate during the reconstruction, see Jean-Claude Vigato, L'Architecture régionaliste, France 1890-1950, Paris, Editions Norma, 1994, pp. 75-138.

[3] The exhibition *La Cité reconstituée* was held in the Tuileries garden from 25 May to 15 August 1916. Louis Gaultier, Exposition de la Cité reconstituée. Esthétique et Hygiène. Rapport général, Paris, 1917. For reviews of the exhibition, see Charles Dupuy, "Exposition de la Cité reconstituée", L'Architecture, vol. 29, August-September 1916, pp. 135-138; Léandre Vaillat, "La Cité renaissante. Le régionalisme en architecture", Le Temps, 19 August 1916.

light building materials, economical and easy to assemble, and destined to address the needs of the populations displaced by the war.

For many critics, the lack of emphasis on the problems of permanent reconstruction was one of the major shortcomings of the exhibition.[4] The leaders of the Société des Architectes Diplômés par le Gouvernement (S.A.D.G.) wished to focus instead on the task of permanent reconstruction. To achieve that goal, it was felt necessary to study the local architecture of the invaded regions.[5] The results of that study was presented at the beginning of 1917 in an exhibition entitled *Le Village reconstitué*, which was to raise one of the major architectural issues of the reconstruction: regionalism.[6] Long before the war ended, architects and institutions confronted the question of what style of architecture was best suited for the reconstruction of the devastated areas.[7]

The exhibition's concern for an architecture responsive to regional characteristics, though shared by most critics and members of the architectural profession, was not without its problems.[8] It posed a challenge first at the level of architectural conception. Were the new buildings to be conceived as emulations or imitations of local architecture, with the permanent risk of producing mere pastiche? The debate on regionalism also revolved around the question of building materials. Commenting on the *Village reconstitué* exhibition, Abel Fabre -- architectural commentator of the Catholic journal La Croix -- hinted at this issue. Fabre wrote:

> Artistic regionalism has its advocates and its opponents. The protagonists of reinforced concrete, like Perret, are against regionalism, considering that the new

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[4] The architect Ernest Picard lamented that the exhibition had only shown wooden constructions and temporary housing. Picard himself exhibited a small permanent rural house built in asbestos bricks. See E. Picard, "La Cité reconstituée aux Tuileries", L'Architecture, vol. 29, August-September 1916, pp. 138-144.

[5] Vigato (see note 2), p. 93.

[6] The exhibition held at the Galeries Goupil in Paris was inaugurated in January 1917.

[7] In a book that collected his writings on this issue, Paul Léon, of the Ministère des Beaux-Arts, wrote: "L'habitation est, comme la flore ou la faune, un élément géographique; elle est étroitement liée à la nature du terrain, aux conditions climatiques, au mode de division et d'exploitatation du sol, à la nature de ses productions...". Paul Léon, La renaissance des ruines, Paris, Henri Laurens, 1918.

[8] Henri Blanchard, "Reconstruction des villes. L'exposition de l'architecture régionale dans les provinces envahies", L'Architecture, vol. 30, February 1917, pp. 27-31; Paul Léon, "L'architecture dans les provinces envahies", Les Arts, no. 157, 1917, pp. 12-19.

building process allows us to overcome the constraints of local climates -- such as in the form of roofs. According to them, we are marching toward a European style that will vary over time, but that will not admit local variations.[9]

Even before the exhibition, the issue of building materials had already been raised by the critic Léandre Vaillat -- a vocal advocate of regionalism in architecture.[10] Did regionalism imply a reconstruction based on the use of local materials, or did it allow the use of modern materials? For Vaillat, the question was conceived in terms of an opposition between natural and artificial materials.[11] In fact, most critics regarded the question of building materials as a critical issue of the reconstruction.[12] Joseph Reinach demanded that the destroyed villages be reconstructed *à la française*, according to the rhythm and style of each region.[13] Reinach feared that "pressed by time, and led by an intellectual laziness and complacency, some would opt for the reconstruction of villages in reinforced concrete, following the model of workers' housing in London or the makeshift construction of the American Far West."[14] Reinach's total devotion to regionalism, however, did not foreclose the question of building materials: "new materials, even artificial ones, should not be discarded in favor of natural materials, which possess in themselves a natural beauty."[15] The issue was what materials were appropriate for the

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9 Abel Fabre, "L'architecture régionale dans les pays envahis", La Croix, 29 January 1917: "Le régionalisme artistiques a des adversaires et des partisans. Les protagonistes du ciment armé, comme M. Perret, lui sont résolument hostiles, estimant que ce nouveau procédé et celui du fer, qui nous font triompher des climats, par exemple dans la forme des toits, doivent fatalement entraîner sa disparition. D'après eux, nous marchons vers un style européen qui variera avec le temps, mais qui n'admettra pas de variétés locales."

10 Vaillat wrote a series of articles published in the journal Le Temps in 1916. The articles were republished under the title La Cité renaissante, Paris, Larousse, 1918.

11 L. Vaillat, "La Cité renaissante. Le régionalisme en architecture", Le Temps, 19 August 1916, p. 3.

12 See especially Georges Wybo's reflections on modernism and new materials in Réflexions et croquis sur l'architecture au Pays de France, Paris, Hachette, 1918.

13 Reinach wrote: "Il ne suffira pas de reconstruire ces villages détruits; il les faudra reconstruire à la française, rien qu'à la française, et encore, selon le rythme et le style de chacune des régions ravagées". Joseph Reinach, Le village reconstitué, Bruxelles-Paris, Van Oest, 1917, p. 7.

14 Reinach (see note 13), pp. 12-13: "Je ne risque pas beaucoup à prédire qu'aux abords de l'échéance, pas mal d'impatiences et d'intérêts se syndiqueront pour réclamer des paresses d'esprit ou de complaisances irréfléchies la reconstruction de nos villages en maisons de ciment armé, sur le modèle d'une cité ouvrière des environs de Londres ou d'une ville improvisée du Far West américain."

15 Reinach (see note 13), p. 13: "...et des matériaux nouveaux, fussent-ils artificiels, ne seront point à écarter en faveur des seuls matériaux qui portent en eux-mêmes une beauté naturelle."

expression of regional characteristics. Supply was also a factor, for in the development of an architecture respectful of local characteristics, the scarcity of materials furnished an incentive to take into consideration the so-called artificial materials.

In La Cité de demain dans les régions dévastées published in 1917, the architects Auburtin and Blanchard present a summary of the problems of the reconstruction.[16] A whole chapter is devoted to the question of building materials. The lack of wood for frame construction is especially noted. Reinforced concrete is presented as an alternative for the construction of beams and floors, as a material that could be substituted for local materials.[17] The urban-planning movement was also sensitive to these question. In a book published in 1918, Léon Rosenthal shows his awareness of the various tendencies at play within the movement for reconstruction.[18] In a chapter entitled "L'architecture nouvelle", Rosenthal rejects the valuation of materials according to their origin, arguing that "there are no base or despicable materials."[19] Rosenthal insists on the role iron and reinforced concrete could play in the reconstruction and in the development of architecture after the war.[20]

The regionalist discourse was not necessarily opposed to the modernization of architecture. In an important article published in 1918, Vaillat discussed the potential use of cement and reinforced concrete as substitute materials.[21] For Vaillat, the contemporary

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16 J.-Marcel Auburtin, Henri Blanchard, La Cité de demain dans les régions dévastées, Paris, Armand Colin, 1917.

17 Auburtin, Blanchard (see note 16), pp. 171-178.

18 Léon Rosenthal, Villes et villages français après la guerre, Paris, Payot, 1918.

19 Rosenthal (see note 18), p. 279: "Il n'est pas de matériaux vils ou méprisables."

20 Rosenthal wrote: "Le fer, le ciment armé sont des matériaux vraiment adaptés à la vie contemporaine. Le fer est loin d'avoir épuisé toutes les combinaisons dont-ils est susceptible. Le ciment armé, matériel tout récent, offre plus d'inconnu encore. Avec ces éléments, qui manquèrent aux artistes du passé, nos architectes disposent d'une puissance inouie; ils sont en mesure de réaliser des audaces naguères interdites et de le faire selon des formules neuves." Rosenthal (see note 18), p. 279.

21 Léandre Vaillat, "Du ciment armé. son esthétique", Les Arts Français, no. 20, August 1918, pp. 149-158. Vaillat wrote: "Ceux qui s'occupent de la reconstruction des provinces dévastées par la guerre savent tous que la pierre et le bois feront défaut, faute de main-d'oeuvre pour les exploiter, faute de fret pour transporter les bois des colonies, faute de quantité pour l'immense tâche à accomplir. Il y a dans le ciment et le béton armé des *matériaux de remplacement* que l'usage a confirmés avant la guerre." (See note 21), pp. 149-150. The goal of the periodical Les Arts Français (published by the Ministère de l'Instruction Publique et des Beaux-Arts) was to fight against the label *Made in Germany* and to sustain the French production of applied arts on the world market.

task was to find ways to adapt the new materials to the execution of recent projects of rural architecture, the form of which derived from ancient and traditional configurations. He cited many examples to show that reinforced concrete as a building process could help achieve many different goals. For Vaillat, the use of modern materials could serve the tenets of regionalism. Yet his distinction between natural and artificial materials opened the door to a renewed conception of building materials.

Reconstruction, industrial processes, and modern materials

The devastation at the end of the war was immense: in the 4,329 communes that had been occupied or evacuated, some 6,147 public buildings -- town halls, schools, and churches -- were razed; 293, 039 dwellings were completely destroyed; another 435,961 homes severely damaged; and 52,734 kilometers of highways needed to be rebuilt.[22] The reconstruction of the devastated areas placed the architectural profession in a totally new situation. For the first time, architects were faced with the problem of quantity -- the sudden production of housing for a very large number of anonymous clients. That problem was to be resolved by reverting to methods used in the industrial sector. The war itself had been a major impetus towards industrial innovation. The formidable task of reconstruction pushed the application of modern productive techniques even further.[23]

The industrialization of buildings first materialized in the practice of prefabrication. At the exhibition *La Cité reconstituée*, many building systems were displayed, for both temporary and permanent housing. Most of the systems exhibited were based on the use of prefabricated elements that could be assembled on the building site. Many were based on the exploitation of reinforced concrete, such as the system of molded houses by the

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[22] William MacDonald, Reconstruction in France, New York, MacMillan, 1922, pp. 24, 28, 93. On the devastation left by the war, see also Jean-Jacques Becker, "Les destructions de la guerre de 1914-1918: coût, ampleur, conséquences démographiques...", Reconstruction et modernisation. La France après les ruines 1918... 1945..., Paris, Archives nationales, 1991, pp. 17-22.

[23] See Mary McLeod, "Architecture or Revolution: Taylorism, Technocracy, and Social Change", Art Journal, vol. 43, Summer 1983, p. 134.

Société Française des Maisons et Constructions Moulées (fig.39), and the system of prefabricated houses by the Etablissements Bonna.[24] The practice of prefabrication in the building industry coincided with contemporary concerns for standardization and Taylorization in the industrial world. In June 1918, the Minister of Commerce and Industry established a permanent commission of standardization and called for the Taylorization of war industries.[25] In 1919, the architect Louis Cordonnier reiterated this call, making a direct connection between standardization and Taylorization.[26]

The notion of Taylorism was not unknown to the architectural profession.[27] As early as 1913, articles discussing Taylorism appeared in the pages of La Construction Moderne.[28] Written by Paul Couturaud, these articles focused on two possible applications of the method: the organization of the factory and/or production, and the organization of the architect's office. In 1918, the architect André Granet published a series of articles discussing the application of Taylorism to the context of the building industry, arguing for the factory management of the building site, which Granet compared to a 'movable factory'.[29] But Granet's interpretation of Taylorism was limited, tied to the management of space rather than the question of production.[30]

By the time of the reconstruction, ideas of standardization, prefabrication, and Taylorism had become commonplace in architectural circles, but these were notions that meant different things to different people. In 1919, Jacques Gréber -- a French architect familiar with the American context -- was invited by the S.A.D.G. to address the

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[24] Gaultier (see note 3), pp. 103-104, 113-114.

[25] See L'Architecture, vol. 31, July 1918, pp. 122-123.

[26] Louis Cordonnier, "Reconstitution des villes. Projet en vue de l'organisation de la reconstruction dans les régions dévastées", L'Architecture, vol. 32, 15 May 1919, pp. 245-254.

[27] On Taylorism and French architecture, see Olivier Cinqualbre, "France 1913-1925. Taylor dans le bâtiment, une idée qui fait son chemin", Architecture et industrie passé et avenir d'un mariage de raison, Paris, CCI/Centre Georges Pompidou, 1983, pp. 198-206.

[28] Paul Couturaud, "Le système de Taylor", La Construction Moderne, 27 April 1913, pp. 356-358; 4 May 1913, pp. 368-369; "Les méthodes américaines. Principes de la direction d'un bureau d'architecte", La Construction Moderne, 18 May 1913, pp. 392-394; 1 June 1913, pp. 416-417.

[29] André Granet, "La taylorisation dans l'entreprise", Le Moniteur des Travaux Publics, de l'Entreprise et de l'Industrie, 17 January 1918, p. 1. He wrote: "usine mobile, il est vrai, mais usine quand même."

[30] Cinqualbre (see note 27), p. 203.

problems of the reconstruction in light of the American experience.[31] In the conference held at the Ecole des Beaux-Arts, Gréber argued that the solution depended on the organization of the production process: on standardization in the building industry. For Gréber, standardization referred primarily to the definition of standard dimensions and to the création of *types standards* -- a standardization of housing types that was based on both the definition of standard dimensions and the production of standard building elements (beams, doors, windows, etc.).[32] For Gréber, standardization could be achieved by means of traditional building techniques. Emphasis was placed on the planning of construction, not the development of new building materials and technique. For Gréber, standardization did not lead to the industrialization of architecture.

For Charles-Henri Besnard -- an architect trained by the Monuments Historiques -- the problem of the reconstruction was also related to the organization of the production process in the building industry. But contrary to Gréber, Besnard emphasized the importance of modern productive techniques.[33] In an article published in 1919, Besnard lamented the fact that the division of labour was not applied in the building industry, a method he believed was despised by architects for not being conducive to the production of works of art.[34] He distinguished between two methods: the prefabrication of all building elements in the factory, and the prefabrication of elements on the building site. Regardless of the method applied, reinforced concrete was viewed as one of the favored

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[31] Jacques Gréber, Organisation des Travaux d'Architecture aux Etats-Unis, Paris, Librairie Centrale des Beaux-Arts, 1919. Gréber's intervention was published by the newly created "Office du Bâtiment et des Travaux Publics pour l'étude de la reconstruction des Immeubles détruits dans les Régions libérées", a government agency devoted to the problems of the reconstruction.

[32] In the Netherlands, Oud questioned the validity of this approach. He wrote: "Much will depend on how far standardization goes: whether it will be the mere definition of standard types (trade standards) of doors, windows, etc., or whether it will mean the design of complete house types." J.J.P. Oud, "Architecture and Standardisation in Mass Construction", De Stijl, vol. 1, no. 7, 1918, pp. 77-79 [English translation: Tim and Charlotte Benton (ed.), Architecture and Design 1890-1939, New York, 1975, pp. 117-118.]

[33] Charles-Henri Besnard, "Les Procédés Modernes de Construction rapide", Art et Décoration, Fall 1919, pp. 27-32.

[34] Besnard wrote: "La division du travail, théorie devenue article de foi chez les métallurgistes, n'est nullement mise en pratique dans l'industrie du bâtiment; la méthode du travail en série, si avantageuse tant par la rapidité des résultats qu'elle donne que par les économies qu'elle permet de réaliser, est méprisée des architectes, qui nient (sans avoir tenté l'essai) la possibilité d'en tirer des oeuvres d'art." Besnard (see note 33), p. 27.

materials for the construction of both temporary and permanent housing. For Besnard, serial production did not necessarily imply ugliness, imperfection, and uniformity: he argued instead that the combination of basic elements could be conducive to the production of formal variety.[35]

Besnard was familiar with the application of new productive techniques. Working in association with the architect André Godard and the firm Bessonneau, Besnard had developed a system of housing construction based on prefabricated elements in reinforced concrete, elements fabricated at the workshop and assembled on the building site to constitute the framework of the house. The main problem with such a system -- which had many precedents -- was the difficulty of preserving the monolithic quality normally associated with reinforced-concrete construction.[36] The various models illustrated in the firm's commercial catalogue sought to demonstrate the potential offered by the combination of basic prefabricated elements (fig.40).[37] "We do not attempt to 'standardize the building industry'. On the contrary, we attempt to devise a new construction process that is flexible and adaptable to any combination."[38] These models also betrayed the architect's desire to respect the forms and symbolism of the traditional house.

Besnard's approach was not inspired solely by new production techniques. It was also influenced by the patenting practice of engineers and entrepreneurs. In 1918, Besnard filed a patent for a "Housing construction system using prefabricated reinforced

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35 Besnard wrote: "Qui dit travail en séries, ne dit pas nécessairement exécution laide. Rien ne s'oppose à la perfection d'une fabrication faite dans ces conditions sur de beaux modèles. Le travail en séries ne crée pas nécessairement l'uniformité, l'on peut varier à l'infini la forme ou la qualité des éléments constitutifs d'une construction." Besnard (see note 33), p. 32.

36 One among the many precedents was the Unit Construction system developed by Conzelman in the United-States. J.-E. Conzelman, "Les progrès de la construction en ciment armé par voûte", Le Ciment Armé, April 1913, pp. 61-74.

37 The system is well described in the commercial publication Les Constructions Bessonneau (catalogue des maisons préfabriquées de la société Bessonneau, Section du ciment armé), Angers, April 1919. A collection of photographs in the Besnard Archive (IFA) testify to the extended activities of the firm during this period.

38 Les Constructions Bessonneau (see note 37), p. 2: "Nous nous défendons de 'strandardiser le bâtiment'. Nous nous sommes efforcés, au contraire, de mettre au point un nouveau procédé de construction, souple à souhait, pouvant se prêter à toutes les combinaisons."

cement elements".[39] The patent was filed under the names of Besnard and Bessonneau, the entrepreneur engaged in the commercialization of the system. In France, the registration of patents for building systems was a common practice among engineers and entrepreneurs but not among the members of the architectural profession. A significant precedent was set in 1912 when the architects Henri Sauvage and Charles Sarazin filed a patent for the building system of the *Immeuble à gradins*.[40] Sauvage's decision was apparently encouraged by Frantz Jourdain, who "advocated that architectural projects be lodged with the National Industrial Patent Office as a safeguard against plagiarism and competition from engineers."[41] Jourdain's advocacy was conceived as a means of defending the creative rights (*droits d'auteurs*) that should be accorded to architects. With the war and the reconstruction, many architects involved themselves in the conception of building systems and building elements. Under these new conditions, the registration of industrial patents received a new impetus.

Many of the patents registered by architects were for systems of prefabricated houses. A well-known example is the system designed by the architects Noël and Patoux for the industrialist and aircraft builder Gabriel Voisin (fig.41).[42] In 1919, Henri Deneux (architecte en chef des Monuments Historiques) filed a patent for a "Construction system of reinforced concrete elements that can be dismantled". Deneux's system was to be used for the reconstruction of the roof of Reims cathedral, destroyed during the war.[43] In 1920, the architect Henri Guimard filed a patent for a "system permitting the construction

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[39] "486.783 - *Procédé de construction rapide d'habitations par l'emploi de matériaux en ciment armé préalablement préparés en série* - 1918 - Bessonneau et Besnard". (I.N.P.I.). The patents, now at the Institut National de la Propriété Industrielle (I.N.P.I.), are grouped under the following sections: Section VII-3: "Travaux d'architecture, aménagement intérieurs, secours contre l'incendie" and Section VII. 1: "Béton armé: procédés généraux".

[40] See François Loyer, et al., Henri Sauvage. Les immeubles à gradins, Bruxelles-Liège, IFA/Mardaga, 1987, pp. 44-47.

[41] Loyer, et al., (see note 40), p. 45.

[42] "497.426 - *Construction à montage et démontage rapide* - 1918 - Voisin". (I.N.P.I.) The system of prefabricated houses developed by Voisin is illustrated in Besnard's 1919 article.

[43] "506.789 - *Procédé de construction en ciment armé à dilatation libre, par petits éléments démontables* - 29 novembre 1919 - H. L. Deneux". (I.N.P.I.)

of a standardized house without the use of traditional quantity measurement."[44] In the aftermath of the war, the practice of patents was to challenge the traditional conception of the architect as an artist, in an attempt to respond to the new context of architectural production. At the same time the practice revealed the emergence of a new conception of building materials and techniques.

Reconstruction, industrial imagery and aesthetic discourse

In the 1919 edition of his Aide-mémoire on reinforced-concrete construction, the engineer Jean Braive presented an overview of the evolution of industrial construction during the war.[45] Braive argued that a sharp rise in the price of metal armatures had encouraged builders to turn to monolithic construction in reinforced concrete, and that by 1916 many had developed new systems of long-span roofs and thin shell roofs. In support of the author's argument, the survey was illustrated with numerous images of industrial structures in reinforced concrete.

The demand of war production was a major incentive for the construction of new industrial structures. The boldness of these structures, most often in reinforced concrete, did not go unnoticed within architectural circles. In an article published in 1919, Henri-Marcel Magne (the new professor of applied arts at the Conservatoire National des Arts et Métiers) proposed a critical reading of the new industrial architecture.[46] Magne was the son of Lucien Magne, a former history professor at the Ecole des Beaux-Arts and professor of decorative arts at the Conservatoire National des Arts et Métiers.[47]

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[44] "529.104 - *Système permettant le montage de tous les éléments de construction d'une maison ordinaire standardisée sans exiger l'emploi du mètre ordinaire* - 28 décembre 1920 - H. Guimard"; "529.106 - *Nouveau système pour la construction de planchers d'étages, avec poutres en ciment armé* - 28 décembre 1920 - H. Guimard". (I.N.P.I.) These are two among the twelve patents filed by Henri Guimard from December 1920 to January 1921.

[45] Jean Braive, Aide-mémoire de l'ingénieur-constructeur de béton armé, Paris, H. Dunod et E. Pinat, 1914, 2nd revised edition, 1919.

[46] Henri-Marcel Magne, "L'Architecture et les Matériaux Nouveaux", Art et Décoration, vol. 36, May-June 1919, pp. 85-96.

[47] Lucien Magne had died in July 1916. See [Anonymous], "Nécrologies [Lucien Magne]", L'Architecture, 1916, nos. 8-9, p. 127. On Lucien Magne's reading of nineteenth-century French architecture, see chapter II.

In his article, Magne reviewed the recent realizations of industrial architecture: the electrical power plant at Saint-Ouen, the arsenal of Roanne, the steelworks of Caen. Going beyond the mere assessment of their technical characteristic, he provided a description of their formal features. Calling the new Caen steelworks the "true temple of modern industry" Magne went on to describe its many features (fig.42).[48] Using a vocabulary appropriate for formal description -- rhythm, proportions, purity of lines -- he approached the building as a major work of monumental architecture. Magne concluded that the steelworks" were full of artistic qualities because they are the living expression of truth, instead of being, like so many contemporary monuments, sterile and dead pastiches".[49] Magne wished to challenge the opposition of art and utility, arguing against the prejudice that placed utilitarian constructions outside the aesthetic realm.[50] Taken as the result of strictly utilitarian goals, the structures described were viewed as important lessons from which architects could learn.[51]

Magne's article was illustrated with striking photographs depicting these new industrial buildings, emphasizing the boldness of the structural elements in reinforced concrete rather than their formal configuration. Dwelling on those images, one observer was to qualify them as "cyclopean constructions" comparable to the visions of a Piranesi.[52] Images of industrial structures in reinforced concrete were common before the war. They appeared widely in commercial periodicals like Le Béton Armé and Le Ciment

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48 An analogy -- the new industrial buildings viewed as modern temples -- that was not uncommon in German architectural culture of the pre-war period.

49 Magne (see note 46), p. 87: "[les Aciéries] sont pleines de qualités artistiques parce qu'elles sont une expression vivante de vérité au lieu d'être, comme trop de monuments contemporains, des pastiches stériles et morts."

50 Magne wrote: "Certes l'on ne dénoncera jamais trop le préjugé par lequel l'art s'arrêterait là ou commence l'utilité, ce qui aurait pour conséquence que les constructions utilitaires, telles que celle-là, n'eussent aucun rapport avec l'art." H.-M. Magne (see note 46), p. 87.

51 Magne (see note 47), p. 87: "Aussi doit-on souhaiter que, sortant enfin des chemins battus, l'architecte de demain sache profiter des leçons à tirer de ces constructions, où partout se manifeste le souci des dispositions meilleures pour l'utilisation, sans s'arrêter à des types connus."

52 Charles Saunier, "L'architecture française du temps présent et les matériaux nouveaux", La Renaissance de l'art français et des industries de luxe, vol. 3, no. 5, May 1920, p. 227.

Armé and in the many treatises on reinforced-concrete construction.[53] But their reproduction generally served a technical and commercial purpose, not an architectural discourse.

The war was to change all that. With the celebration of industrial production, the war induced new perceptions of both the meanings and the forms of the industrial world. The impact of the new industrial reality was widespread, penetrating all ideological and cultural circles. A comment by the regionalist writer Léandre Vaillat is revealing of this changing attitude. In Le décor de la vie, published in 1918, Vaillat evoked the beauty of the modern factory: "A factory can be endowed by a sort of beauty which satisfies the intelligence as well as the gaze."[54] Making a direct connection between the formal appearance and the organization of the factory, Vaillat approached the factory as an efficient metaphor to describe the social and physical environment.

A most compelling piece of evidence of the newfound interest in the figures of the industrial world was the publication of Tony Garnier's La Cité industrielle in 1917.[55] Though the idea and early drawings of the *Cité industrielle* dated from the time Garnier was at the Villa Médicis in Rome, the 1917 publication was largely derived from buildings Garnier executed in Lyon from 1906 onward.[56] Most of the projects depicted were based on applications of the possibilities offered by reinforced-concrete construction (fig.43). In Lyon, Garnier had also made use of metal construction, as in the case of the roof structure of the Abattoirs de la Mouche (1906-28). Yet that project had been

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53 On this question see my article, "La circulation de l'image", Le Béton en représentation. Mémoire photographique de l'entreprise Hennebique 1890-1930, Paris, Hazan, 1993, pp. 77-94.

54 Vaillat wrote: "Une usine peut être douée d'une sorte de beauté forte qui satisfasse à l'intelligence autant qu'au regard... Il y a des usines laides et d'autres très belles: les unes mal installées, médiocrement aménagées, où se trahit la hâte, l'improvisation, la pauvreté des moyens hésitants, la timidité d'une tentative sans confiance: les autres, au contraire, réalisent pleinement une formule audacieuse et traduisent la liberté d'allures des grands manieurs d'affaires...". Léandre Vaillat, Le décor de la vie, Paris, La Renaissance du Livre, 1918.

55 Tony Garnier, Le Cité industrielle, étude pour la construction des villes, 1917, (reprint, Paris, Philippe Sers éditeur, 1988).

56 On the dating of the *Cité industrielle*, Olivier Cinqualbre convincingly argues that most of the projects published in 1917 derived from Garnier's work in Lyon after 1906. O. Cinqualbre, A. Guiheux, Tony Garnier, L'oeuvre complète, Paris, CCI/Centre Georges Pompidou, 1990.

originally conceived with a reinforced-concrete structure, a technical and constructional choice that was to leave a strong imprint on its formal configuration.[57] The publication of the *Cité industrielle* coincided with the growing interest in the new industrial reality. Its graphic content was a major contribution to the discourse on the functional and aesthetic qualities of domestic, public, and industrial architecture.

Contemporary criticism: architecture and reinforced concrete (1918-20)

At the end of the war, the new industrial architecture was generally depicted by means of images of building and structures in reinforced concrete. Yet if the period was favorable to a celebration of the material, the question of its aesthetic treatment in architecture remained a subject of debate.[58] In 1918, Léandre Vaillat devoted a long article to the aesthetic possibilities of reinforced cement in architecture.[59] Despite its broad scope, the aesthetic issue was rapidly narrowed down to the question of the material's external appearance. Vaillat questioned the assumption of the intrinsic ugliness of cement. Discussing the various means developed to decorate or dissimulate the material, Vaillat called for the treatment of the cement skin, the treatment of the matter itself.

Though favorable to the use of reinforced concrete, Vaillat made a point of distancing himself from the position defended by Anatole de Baudot. The Rationalist viewpoint had received renewed attention with the publication of de Baudot's L'Architecture, le passé, le présent in 1916.[60] A posthumous publication prepared by one of his followers, the book presented the synthesis of de Baudot's teaching at the Trocadéro. Since the course had been given during the first decade of the century, the book was clearly rooted in prewar architectural debates. De Baudot had recurrently insisted on the distinction between reinforced concrete and reinforced cement, arguing that

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[57] Cinqualbre, Guiheux (see note 56), pp. 146-150.
[58] See [Anonymous], "Supériorité du béton armé" and "Résistance du béton armé aux tentatives de destructions boches", Le Béton Armé, no. 2, 25 July 1919, pp. 26-29.
[59] Vaillat (see note 21).
[60] Anatole de Baudot, L'Architecture, le passé, le présent, Paris, Henri Laurens, 1916.

only the latter had the potential to bring about an architectural renewal. For de Baudot, reinforced cement was a process which provided a *new mode of structure*.[61] But the quality of reinforced cement as a structural material was overshadowed by the problem of its external appearance. A major concern for architects and clients, the appearance of the cement surfaces had to be improved by different decorative methods. Of the few methods available, de Baudot favored the one which sought to enliven the cement surface itself.[62]

Despite its rootedness in the prewar period, de Baudot's doctrinal position remained a point of reference for the postwar discussion on modern materials in architecture. In his Théorie de l'architecture published in 1919, Alcide Vaillant discussed the nature and appropriate use of materials.[63] A special chapter was devoted to a discussion of rational architecture and new materials, in direct response to de Baudot's book.[64] Rejecting Rationalist claims regarding the potential of the new material, Vaillant wrote that "there are no reasons to make of reinforced cement the universal and exclusive structural means of architecture."[65] As the product of industrial combinations, reinforced concrete was less economical than traditional masonry, and it lacked volume and weight, the most important constituent of architecture. For Vaillant, reinforced concrete could not be conceived as a proper *material* in the sense of the academic tradition, but only as an *appareil de construction*.[66]

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61 De Baudot wrote: "Quoi qu'il en soit, il résulte clairement des applications déjà faites que nous sommes en possession d'un *mode nouveau de structure* qui permet de résoudre le problème moderne dans toutes ses exigences." De Baudot (see note 60), p. 169.

62 De Baudot (see note 60), pp. 187-188.

63 Alcide Vaillant, Théorie de l'architecture, Paris, Nouvelle Librairie Nationale, 1919. The preface of the book was headed with an excerpt by Maurice Barrès, famous anti-Dreyfusard and author of Les Traits éternels de la France (1916). According to Vigato, the notion of order is at the heart of Vaillant's Théorie de l'architecture, a theory grounded on the Vitruvian heritage. See also A. Vaillant, "'Simplifions' en ordonnant", La Construction Moderne, 15 April 1915, pp. 1-2.

64 Vaillant, Théorie de l'architecture (see note 63), pp. 397-404.

65 Vaillant (see note 63), p. 401: "Il y a donc des raisons sérieuses pour être réservé, et il n'y en a pas pour faire du ciment armé l'universel, l'exclusif moyen structurel de l'architecture."

66 Vaillant wrote: "Notons, à ce propos, que le béton ou ciment armé n'est pas un matériel -- un "matériau" comme disent ses fanatiques -- mais un *appareil de construction* de très haute résistance." Vaillant (see note 63), p. 144.

While Vaillant was a staunch opponent of de Baudot's doctrine, others were to turn his critical position into an unproblematic reading of modern materials. In 1919, Emile Bayard published a retrospective review on the sources and works of the modern style in France.[67] Bayard paid much attention to the role of modern materials in the development of architecture. Making direct reference to the teaching of de Baudot, Bayard insisted on the importance of reinforced cement in the future of architecture. The author also raised the aesthetic issue, but only to recall the well known Rationalist discussion on the material's decoration. Bayard's straightforward adoption of the Rationalist argument may appear as a surprise since he was affiliated with Beaux-Arts institutions, but it shows that by the end of the war the Rationalist discourse on modern materials had largely penetrated other architectural circles. It is also revealing of the persistence of prewar theoretical positions in the early architectural writings of the postwar era.

One of the first critics to confront the prewar debates with the postwar context was Henri-Marcel Magne. As we saw above, Magne's approach to modern materials was framed by the issue of the aesthetic of industrial buildings.[68] Magne argued that the war had a positive effect on the development of industrial architecture in reinforced concrete, and since these new utilitarian works possessed authentic artistic qualities, Magne urged architects to take them as examples. But this integration of a new parameter -- industrial architecture -- did not suffice to invalidate traditional aesthetic qualifications concerning building materials. Magne wrote: "But if in such works, defined by lines and mass, reinforced concrete has a quality of its own, it has, for architectural constructions, the same defects as the bonding materials previously used, because of its grey tone as well as

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[67] Emile Bayard, Le Style Moderne (in the collection "L'Art de reconnaitre les styles"), Paris, Garnier, 1919. Bayard was inspector at the Ministère des Beaux-Arts and secretary of the Commission de l'enseignement du Comité Central Technique des Arts Appliqués.
[68] Magne (see note 46). See also: H.-M. Magne, L'Enseignement de l'art appliqué aux métiers, Paris, Henri Laurens, 1918.

its rough aspect."[69] What was considered valid for utilitarian works remained unacceptable for architectural constructions.

Concerned by the aesthetic poverty of the material, Magne called for the adoption of appropriate means of revetment and decoration. The methods advocated were to be inspired by the Byzantine, Roman, and Renaissance models. This choice was motivated by the construction process itself. Comparing the brick arches of Roman construction to the metal armatures of reinforced concrete, Magne viewed the construction method based on the use of *matériaux de liaisonnement* as the antecedent of reinforced-concrete construction. The analogy between the two historically distant building methods was sufficient to motivate the adoption of the same decorative techniques.[70] For Anatole de Baudot, reinforced cement was conceived as an improvement of metal construction. Proposing a different historical affiliation, Magne situated reinforced-concrete construction in continuity with architectural forms and decoration. With Magne, the evocation of historical examples took precedence over technical explanation. The challenge posed by the new industrial architecture was somewaht neutralized by the conventions of architectural aesthetics. Focusing on the question of the material's external appearance, Magne's interpretation reaffirmed the continuity with the debates of the 1900s.

The war and the reconstruction were together a major incentive in the acceptance of modern materials. But while many of the critics could celebrate the use of reinforced concrete in industrial architecture, their conception of its architectural treatment tended to fall back on conventional notions of surface decoration, and by 1920 the discourses on modern materials and modern architecture remained largely framed by prewar theoretical

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69 Magne (see note 46), p. 91: "Mais si, dans de tels ouvrages, qui ne comptent que par une ligne et une masse, le béton armé vaut par lui-même, il a, pour les constructions architecturales, les mêmes défauts que présentaient les *matériaux de liaisonnement* employés jadis, tant en raison de sa tonalité uniformément grise que de son aspect fruste."

70 Magne wrote: "Le rapprochement entre l'expression d'art de ces édifices et celles que nous devons rechercher aujourd'hui, s'impose quand on songe que leur mode de construction en matériaux de liaisonnement est précisément l'antécédant de l'emploi du béton armé." H.-M. Magne (see note 46), p. 88.

viewpoints. The critic Charles Saunier -- an attentive observer of architectural developments in the 1900s -- believed that architecture could only be changed by an elite, an elite inspired by the teaching of the Rationalist masters.[71] In the early years of the 1920s, a major challenge to the current conception of modern materials and to modern architecture was to come from the contributions of Auguste Perret and Le Corbusier.

2. Architecture and Construction: Perret and the the training ground of industrial architecture

In 1923, Auguste Perret and the Perret Frères building firm completed the construction of the church of Notre-Dame de Consolation at Le Raincy. The entire building was made out of a single material: reinforced concrete, left bare after the removal of the formworks. The building was hailed as a fundamental contribution to monumental architecture, both for its overall formal conception and its straightforward treatment of materials. In the studies on Auguste Perret, the church has become a convenient point of reference to evaluate the course of his architectural trajectory. But in 1923, the church was firstly perceived as a landmark in the development of French reinforced-concrete architecture.

In a recent study on the work of Auguste Perret and the Perret Brothers building firm, Joseph Abram examines the church at Le Raincy in light of the Perrets many years of experimentation with reinforced-concrete construction.[72] Auguste Perret and the firm broadened their experience of the material with the construction of many industrial structures between 1914 and 1921. Abram insists on the role played by the Wallut warehouses in Casablanca (1914-17) and the Ateliers Esders (1919) in Paris in the conception and construction of the Raincy church. For Abram, these projects are in continuity with Perret's prewar experiences and contribute to the consolidation and

[71] Saunier wrote: "Ceux qui la composent tiennent des maîtres rationaliste, leurs précurseurs, une éducation où l'art et la science ont une part égale. Les ancêtres dont l'esprit les domine, c'est Labrouste, c'est Viollet-le-Duc." Charles Saunier, "L'architecture française du temps présent et les matériaux nouveaux", La Renaissance de l'art français et des industries de luxe, vol. 3, no. 5, May 1920, pp. 222-23.
[72] Joseph Abram, "A. et G. Perret une monographie. 1e partie: architecture, entreprise et expérimentation", research report, Nancy, L.H.A.C. / B.R.A., 1989.

refinement of the structuralist position asserted in 1913.[73] In the following section, I examine the experiences and projects which led to Perret's conception of the Raincy church. I shall argue that with the church Perret advanced a new understanding of the relation between architecture and construction.

Perret Frères: construction and industrial architecture

Beginning with the rue de Ponthieu garage in 1906, the Perret brothers began to specialize in the conception and execution of reinforced-concrete constructions. In the years to follow, they improved their knowledge of the material with the execution of projects in North Africa, such as the completion of Oran cathedral in Algeria by Albert Ballu (1908-12) and the construction of the Magasins Modernes in Casablanca by A. Delaporte (1912-14). In the garage project (1906-07), the configuration of the structure was similar to the Hennebique system. With the Champs-Elysées theater (1911-13), the reinforced-concrete structure was carefully adapted to fulfil the architect's requirements. In the course of a few years, Auguste Perret and the firm had gradually adapted a conventional building system to the constraints of an architectural program.

The activities of the Perret brothers were disturbed by the war. After a short term in the army, Auguste Perret was assigned to the technical office of the Société de Navigation Aérienne.[74] Also enlisted, Gustave Perret was involved in the conception of a system for the prefabrication of temporary wooden barracks. For his part, Claude Perret apparently continued the activities of the firm in North Africa. The only documented project executed by the firm during the period of the war are the Wallut warehouses in Casablanca (1914-17). It is only with the armistice and the building activity of the postwar period that

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[73] Abram writes: "Ce perfectionnement 'technique' du savoir accumulé par leur agence-entreprise, ne remettra pas en cause leurs présupposés doctrinaux, mais conduira, au contraire, à un approfondissement (ou si l'on veut à un affinement) de la ligne architecturale et structuraliste affirmée en 1913." Abram (see note 72), p. 132.

[74] Ten days after the start of the war Auguste Perret enlisted in the infantry and was mobilized at Blois. In March 1915, Perret was transferred to the technical office of the Société de Navigation Aérienne. For a well documented biography of Auguste Perret, see Roberto Gargiani, Auguste Perret 1874-1954. Teoria e opere, Milan, Electa, 1993, pp. 7-28.

Auguste Perret and the firm resumed their building practice in France. While most architects were then involved in activities related to the construction of housing or public buildings, the Perrets were mostly involved in the design and execution of industrial buildings. Auguste Perret was not oblivious to the housing problem; a few extant drawings related to mass housing projects reveal his concern for the design of the postwar worker's house.[75] One of these projects was even published by Le Corbusier in the December 1921 issue of L'Esprit Nouveau.[76] But this publication tells more about Le Corbusier's current activities and concerns than about Perret's.

Before the war, the *agence-entreprise* of the Perret brothers was an original and uncommon organization of production.[77] As architects, the Perrets were working on the margins of the profession. Their combination of architectural and entrepreneurial practice ran against the rules formulated by the Code Guadet and the current definition of professional practice.[78] But with the reconstruction, professional architects were confronted with a new context of production. Professional organizations were hard pressed to find a middle course between the need to adopt new organizational methods and the need to retain the traditional definition of the architect as artist.[79] Before the war, the architect was viewed as an intermediary between the client and the entrepreneur. After the war, architects often found themselves in competition with entrepreneurs. The latter seemed to possess all the skills necessary to fulfil the tasks of reconstruction.[80] In a book

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75 Drawings for these projets are in the Perret Archive (535 AP 15/4, 317). See also Perret's project for Maisons ouvrières (1920) preserved at the Fondation Le Corbusier (FLC, L3.18.7-6), published in G. Fanelli, R. Gargiani, Perret e Le Corbusier, confronti, Roma-Bari, Laterza, 1990, p. 100.

76 Le Corbusier-Saugnier, "Maisons en série", L'Esprit Nouveau, no. 13, December 1921, pp. 1525-1542.

77 See Joseph Abram, "An Unusual Organization of Production: the building firm of the Perret Brothers, 1897-1954", Construction History, vol. 3, 1987, pp. 75-93.

78 On the profession's definition, see A. Louvet, L'art d'architecture et la profession d'architecte (1911). Louvet's book was reviewed by Ch. Dupuy in L'Architecture, vol. 24, 1911; vol. 26, no. 25, 21 June 1913, p. 199. See also A. Vaillant's discussion of professional practice in his Théorie de l'architecture (see note 63).

79 See Jacques Hermant, introduction to Gréber (see note 31), p. 2.

80 See Office du Bâtiment et des Travaux publics, Conférence du Bâtiment pour la Reconstitution des Régions dévastées, Paris, 1918. One of the underlying task of the conference was precisely to discuss the respective competence of architects and entrepreneurs.

published in 1921, Paul Gallotti -- former editor of Le Béton Armé published by the Hennebique firm -- celebrated the rising figure of the entrepreneur, portraying him as a major actor in the construction of modern society.[81] By the turn of the 1920s, the practice of the Perret brothers was unique but not anachronistic. But the merging of architecture and construction was perceived as a challenge to the definition of the professional practice itself.

On the eve of the war, the Perret firm had become a full fledged technical office in reinforced concrete-construction. With the execution of the warehouses in Casablanca during the war, the building firm began to experiment with some of the possibilities offered by the system. Commissioned by the industrialist Wallut, the program required the construction of a warehouse for agricultural machinery. While the original plans were for a wood-frame building, the Perrets opted for a post and beam structure covered with a series of parallel, low barrel vaults in reinforced concrete (fig.44).[82] These vaults, spanning nine meters, were only six centimeters thick at their extremities, and three centimeters at their center (fig.45). The external walls were constituted by the frame with a brick infill.

The design of these thin shell vaults of the Casablanca warehouses is often hailed as a revolution in reinforced-concrete construction. While the warehouses are generally attributed to Auguste Perret, it must be emphasized that their design was developed in collaboration with Louis Gellusseau, the engineer of the Perret firm. By that time, the construction of thin shell vaults had already been experimented with by engineers and specialized firms. In 1910, similar vaults designed by the engineer Simon Boussiron were built at the Bercy train station in Paris.[83] With the construction of the Wallut warehouses,

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[81] Paul Gallotti, L'entrepreneur à travers les Ages, Paris, Librairie de l'Enseignement Technique, Léon Eyrolles, 1921. Reviewing the book, Vaillant contested Gallotti's claim regarding the great contribution made by the entrepreneur in contemporary society. See A. Vaillant, "L'entrepreneur et...", L'Architecture, vol. 34, no. 16, 25 August 1921, pp. 6-8. A copy of the book was in Perret's personal library (Paris, Conservatoire National des Arts et Metiers [CNAM], E114).

[82] Drawings for this project are in the Perret Archive (535 AP 8/2).

[83] See J. B. Ache, "Les précurseurs de la révolution architecturale 1850-1930", L'Architecture d'Aujourd'hui, vol. 34, nos. 113-114, 1964, p. 6.

the Perrets merely tested and exported a building technique already available. Their innovative character was emphasized only later, serving in the promotion of Perret's work as a builder.

The only other wartime project in which Auguste Perret was directly involved is the design for an airship shed in 1917. Assigned to the technical office of the Société de Navigation Aérienne, Perret was involved in the conception of an airship shed to be built at Bizerte in Tunisia. Again, the design of the airshed was done with the collaboration of the firm's engineer, Gellusseau. The correspondance between Gellusseau in Paris and Perret in Tunisia reveals the extent of the engineer's role in the conception of the shed.[84] The large span of the shed was to be achieved by means of a metal structure in the form of hinged arches. Most of the extant drawings document the various configurations of the reinforced-concrete abutments on which the metal arches were to rest (fig.46). They are indicative of a process where construction was almost treated as a problem of architectural design.

The first major structure built after the war was the Esders workshop in Paris (1919).[85] The program called for the erection of working spaces for a clothing company. The building plan was a large rectangle subdivided by a series of seven-meter bays. The building was conceived as a central nave surrounded by two storeys of mezzanine floors. The structure of the nave depended upon two semicircular arches spanning twenty meters and supporting the main beams of the glazed roof. The mezzanines, which acted as a brace for the entire structure, were based on a system of low-vaulted floors perfected by the Perret firm (fig.47). This system of vaulted floors was no doubt related to the system of roof vaults developed for the construction of the Casablanca warehouses. More pointedly, however, the floor system devised for the Esders workshop could be related to the practice of vaulted floors in metal and brick common at the end of the nineteenth-

[84] Gellusseau's correspondance with Perret contains a number of conception sketches (Fonds Perret, 535 AP 15/1, 327).
[85] Drawings for this project are in the Perret Archive (535 AP 13/1).

century.[86] These vaulted floors present formal characteristics that are strikingly similar, in terms of both curvature and dimensions, to the reinforced-concrete floor system developed by Perret.[87] While this shape allowed for a greater economy of material, the use of reinforced concrete instead of brick enabled the builder to dispense with buttressing.

Among the few industrial buildings designed by the firm between 1919 and 1923, the Usine R. Wallut et Cie. (1919-20), the Fonderie Grange et Cie. (1919-23), and the Ateliers Marinoni (1920-23), all located at Montataire (Oise), offered further occasion to experiment with the possibilities of reinforced-concrete construction.[88] The Marinoni workshop was a conventional industrial structure lit from the top by means of the traditional roof sheds. The entire structure was made of square posts and beams in reinforced concrete. The external walls were constituted by the bare reinforced-concrete frame with an infill of agglomerate blocks and bricks. The Perret firm revised the system of roof sheds, devising a new roof system of thin parabolic vaults in reinforced concrete (fig.48). The smooth, curved surface of the vaults acted as a diffuser for the light entering from the continuous glass panes provided by the roof system.

The system developed for the construction of the mezzanine floors of the Esders workshop was filed for a patent in February 1920 (fig.49). The patent was defined as an "Improvement in the construction of floors and roofs in reinforced concrete".[89] First experimented with for the floors of the Esders workshop, the system was adapted to the construction of the parabolic shed roof of the Marinoni workshop.[90] The advantages of the system were spelled out in the patent. With the reduction in the number of formworks

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86 I wish to thank Guy Lambert, who is studying Perret's patent for his master's thesis at the Université de Tours (France), for sharing this hypothesis with me.

87 See J. Denfer, Maçonnerie (Encyclopédie des Travaux Publics), Paris, Librairie Baudry, 1891, pp. 24-27.

88 Drawings for these three projects are in the Perret Archive (535 AP 10/5, 10/6, 10/7, 11/1, 11/2).

89 "510.802 - *Perfectionnements apportés à l'établissement des planchers et des toitures en ciment armé* - 27 février 1920 - Perret Frères"; "25.480 - 1ère addition au brevet d'invention no. 510.802 - 3 octobre 1921 - Perret Frères". (I.N.P.I.)

90 Napoléon de Tédesco, "Couverture en sheds des Ateliers J. Voirin, à Montataire", Le Constructeur de ciment armé, vol. 4, no. 29, February 1922, pp. 32-33.

needed and the possibility of rapid reuse, the new system allowed for a great economy in terms of materials and execution time.[91] With this patent, the Perrets addressed one of the main problems of reinforced-concrete construction. Since reinforced concrete had to be cast on site, the quality of its execution greatly depended on the crafting and handling of the formwork. Focused on this problem, the system devised by the Perrets introduced the standard form and repetition.

The Perrets' concern for the problem of the formwork is further highlighted by their short-lived interest in the use of a new industrial technique: the "Cement Gun". On one of the drawings describing the construction of the floor vaults at the Esders workshop, the caption suggests the use of the "Cement Gun".[92] The "Cement Gun" was a system of sprayed cement developed by the American firm Ingersoll-Rand. By spraying cement onto a metal armature -- or any other appropriate surface -- the process enabled the production of the envelope or the revetment of buildings and industrial structures without, as the contemporary advertisement in Le Béton Armé underlined, recourse to costly formworks.[93] The use of this new industrial technique by Auguste Perret was also suggested in the caption of his mass-housing project published in the December 1921 issue of L'Esprit Nouveau.[94] But no subsequent mention of the technique appears in the construction drawings of the early 1920s or in the text of the floor patent, suggesting that the Perrets probably abandoned the technique before making any serious attempt to use it

91 In the patent, Perret wrote: "La pose de ces cintres est très simple, et leur enlèvement peut être effectué d'une manière facile et rapide, très peu de jours après le bétonnage, grâce à la forme courbe des diaphragmes qui permet d'annuler pratiquement les moments de flexion dûs au poids propre. Ces cintres ne sont ainsi immobilisés que pendant très peu de temps, ce qui permet de les utiliser à nouveau en assurant ainsi un travail continu." Text of patent 510.802 (see note 89).

92 Ateliers Esders, drawing no. 20.2.21, not dated (c. 1919) (Fonds Perret, 535 AP 13/1).

93 [Anonymous], "Le Cement Gun", Le Béton Armé, no. 3, 25 December 1919, p. 70: "On conçoit que le principal avantage de cet appareil est d'éviter l'emploi de tout coffrage puisque le mortier adhère de suite très fortement à la paroi recouverte."

94 The caption of Perret's mass housing project read: "Le mode de construction employé est la projection, par l'air comprimé, de plâtre ou de mortier de ciment sur une carcasse en lattis mécanique." Le Corbusier-Saugnier (see note 76), p. 1527. According to the caption, the floors of Perret's project were to be supported by a thin vaulted shell in cement.

on a large scale. From then on, the Perrets were rather to focus on the crafting of the formwork.

Many of the patents developed at the time were for systems exploring the various possibilities potentially offered by reinforced concrete: prefabrication, serial production, etc. In these patents, the focus was on the building element, not on its casting apparatus. Most of these patents would sacrifice the monolithic quality obtained by the building system for the flexibility of assemblage of prefabricated elements. While many systems focused on the prefabrication of building elements, the Perrets' attempted to bring the technique of prefabrication to the building site.

At the time the Perrets sought the legal protection of the patent, they were at once an architectural office, a reinforced concrete specialist, and a building firm. For the architect, the patent was often conceived as a means to gain control over technique and material. For the concrete specialist, the patent was a normal step in the development of the firm's specialization. In this respect, the practice of the Perret Brothers firm was comparable to another firm specialized in reinforced-concrete construction -- Limousin -- which in 1920 had also filed for a patent covering a similar application.[95] However, due to the unique organization of their firm, the patent registered by the Perrets was a technical refinement endowed with a latent architectural potential.

Perret and the design of the Raincy church

The church at Le Raincy was conceived in continuity with the entrepreneurial activities of the Perret firm. As the preserved documents attest, the first project for the church was designed by the engineer A. Guyot in February 1922.[96] The Perrets' first study for the church is dated March 1922. Their plan was based on the general outline proposed by Guyot. It appears as an adaptation in reinforced concrete of the original proposal for a

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95 "517.161 - *Système de construction de sheds en béton armé en forme d'arcs de cloitre* - 1920 - Société Limousin et Cie.". (I.N.P.I.)

96 One blueprint drawing signed and dated 9 February 1922 (Fonds Perret, 535 AP 17/1).

masonry construction with a wooden roof structure (fig.50). But the Perrets did not limit their intervention to the adaptation of the new structure to the dimensions of the original project. The project itself was gradually transformed in its proportions, internal volume, and compositional elements. A few extant drawings document this transformation. Guyot's original plan -- a combination of paleo-Christian and Presbyterian church architecture -- was based on a central nave with side aisles and a small transept. The Perrets gradually transformed the plan, eliminating the transept and raising the aisles to create a single volume. The drawings also show the development of a light columnar system of support, a complex roofing system of vaults and ribs, and a light wall enclosure made of concrete blocks. Called in as a specialized building firm, the Perrets took over both the design and the execution of the church, following a course of events recalling that of the Champs-Elysées theater.

The use of reinforced concrete for the construction of churches was not new. In 1908, the Perret Brothers firm was hired to complete the construction of Oran cathedral (1900-12) designed by the architect Albert Ballu. They substituted a reinforced-concrete skeleton for the structure in reinforced brick that had been only partially executed by the French builder Paul Cottancin. On the eve of the war, the architects Droz and Marrast had employed the Hennebique system to build the church of St-Louis de Vincennes in Paris, a church only completed after the war. In 1919, Le Béton Armé suggested the adoption of reinforced concrete for the reconstruction of churches in the devastated areas.[97] In the main example described, the article suggested the adoption of the Byzantine model, the use of local materials for the infill, and the use of applied decoration such as marble and mosaic.

Perret's executed project radically departed from the structural and decorative example provided by the Byzantine model. The entire church was built of reinforced

[97] P. Noulin-Lespès, "La reconstruction des églises dans les régions dévastées", Le Béton Armé, no. 3, 25 December 1919, pp. 50-52. In the same issue, the editor provides a list of churches built with the Hennebique system of reinforced concrete.

concrete: columns, roof, and external enclosure. The light columnar system of supports was made of thin fluted columns in reinforced concrete that supported a roof made of two reinforced-concrete membranes stiffened by transverse ribs. The inner shell consisted of a longitudinal barrel vault running the whole length of the building, with a series of transverse barrel vaults supporting it on either side. The complex system of transverse vaults and ribs was designed to absorb the thrust of the main longitudinal vault.[98] As was noted by an engineer reviewing the project, "these shallow vaults derive from the vaulted floors without ribs that the Perrets have already applied to numerous constructions, the use of which has been extended to the construction of shed roofs."[99] The conception of the church was thus largely based on the exploitation of the formal possibilities offered by the structural elements in reinforced concrete experimented with by the firm since the construction of the Casablanca warehouses.[100]

The external enclosure was constituted by a perforated membrane in reinforced concrete, made from the assemblage of prefabricated square concrete blocks called *claustra.* These blocks were similar to those developed around 1908 for sections of the walls of Oran cathedral. One of the most striking features of the church was the treatment of the concrete surfaces. After the removal of the formworks, both the columns and the vaulted ceiling were left in rough concrete, a decision that was motivated by economic restrictions.[101]

While Perret's decision to build a church entirely out of concrete appears to have been based on the limited funds available, it was also encouraged by a contemporary movement that strongly supported the use of modern materials in religious architecture.

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98 This complex system of vaults which enables the absorption of the lateral thrust was first studied by Perret in a project for airplane shed -- dated around 1920 -- for the Service de la Navigation Aérienne.

99 Dantin wrote: "Ces voûtes très surbaissées dérivent des planchers voutés et sans nervures que MM. Perret ont appliqués déjà à de nombreuses constructions, et dont ils ont même étendu l'emploi à des toitures sheds." Ch. Dantin, "Constructions civiles. L'église en béton armé du Raincy", Le Génie Civil, vol. 43, Tome 83, no. 1, 7 July 1923, pp. 1-4.

100 On this question, see G. Fanelli, R. Gargiani, Auguste Perret, Roma-Bari, Laterza, 1991, p. 45.

101 Peter Collins argues that the Raincy church was the first example of brutalism in modern architecture. Peter Collins, "The new brutalism of the 1920s: the effect of economic restraints at Notre-Dame du Raincy", Society of Architectural Historians Journal, vol. 33, no. 3, 1974, p. 233.

Though the movement existed before the war, it was strengthened by the new conditions posed by the war destructions. In 1916, the Société St-Jean organized an architectural competition that called for the design of temporary churches.[102] Among the promoters of this movement was Father Abel Fabre, art critic of the journal La Croix. At the height of the debate on regionalism and its role in the reconstruction of churches destroyed by the war, Fabre argued that there was no need to imitate the forms of the past: "We refuse to pledge allegiance to any ancient style and we abandon the imitation of the forms of the past."[103] Discussing the role played by modern materials, he added: "We welcome all the new materials, especially reinforced materials [i.e., concrete], and we want to use them according to their own quality and without concealing their role."[104]

Fabre had met Auguste Perret in March 1916.[105] In 1918, Fabre announced the creation of a group of artists involved in liturgical art that sought to work collectively following an elaborate set of principles.[106] The architects of the group (among them Storez and Droz) were to attempt to execute logical, rational constructions, where forms would derive from materials. On the eve of the construction of the Raincy church, Fabre praised the Perret's intended adoption of visible reinforced concrete.[107] At the time the Perrets took over the church commission, the idea of a reinforced-concrete church built without any decorative ostentation was already broadly advocated within artistic circles involved in religious art.

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102 André Michel, "Projets d'Abris provisoires pour les paroisses dévastées", Journal des Débats, 17 February 1916 (Fonds Perret, 535 AP 330). Perret submitted a project for a church with a roof made of *fibro-ciment*.
103 Abel Fabre, "Propos d'architecte", La Croix, 31 March 1917: "Nous ne nous inféodons à aucun style ancien et nous renonçons à copier pour elles-mêmes les formes d'autrefois."
104 Fabre (see note 103): "Loin de les repousser, nous accueillons avec sympathie tous les matériaux nouveaux, en particulier les matériaux armés, décidés à les employer selon leur qualités propres et sans dissimuler leur rôle."
105 Letter from Marcel Storez to Auguste Perret, 15 March 1916 (Fonds Perret, 535 AP 318).
106 Abel Fabre, "L'Arche", La Croix, 15 December 1918. On the contemporary debate on the renewal of religious art, see Jacques Mauritain, Art et scolastique, 1920.
107 A. Fulcran [alias Abel Fabre], "L'église du Raincy", La Croix, 7 Septembre1922. Fabre wrote: "Cette matière honnête qu'est le ciment restera apparente, car aucune concession n'a été faite à des pratiques invétérées qui veulent à tort la recouvrir, la plâtrer, la dissimuler."

Auguste Perret's own comments on the church were scant. In a 1925 interview, Perret commented on his design conception: "The church at Le Raincy is first and foremost a construction. It is a construction that we have attempted to turn into architecture by placing as harmoniously as possible the elements which compose the construction."[108] Perret's conception was exemplified in his treatment of the columns, where a structural support was turned into an architectural element. Perret justified the round shape of the columns with a constructional argument: the round shape reflected the theoretical section of a loaded vertical element.[109] The fluting of the columns found an analogous explanation. The fluting was justified on the basis that it alleviated the imperfections resulting from the fabrication of the columns since it hides the vertical joints of the shuttering. Yet the aesthetic function of the fluting is ultimately grounded elsewhere. Perret wrote: "The fluting increases the slenderness of the posts and specifies their *caractère*. And *caractère* is one of the necessary conditions of beauty."[110] Perret's concern for the aesthetic of the columns is furthered confirmed by their slight tapering. Perret gave the nave columns a modest entasis of 7 cm less width at the top than at the bottom, an operation that demanded careful craftsmanship. He strove to explain the church's formal and decorative features by means of constructional arguments. But the architectural nature of the building was ultimately derived from its appropriate use of architectural language, not its industrial vocabulary. For Perret, construction could become architecture only when the language of architecture itself was respected.

The construction of the church at Raincy is revealing of Perret's conception of the relation between the technique of reinforced concrete and the idea of industrialization.

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108 Perret stated: "L'Eglise du Raincy, est avant tout une construction. C'est une construction dont nous avons essayé de faire de l'architecture, ce, en disposant aussi harmonieusement que possible les éléments nécessaires qui composent la dite construction." Marcel Mayer, "Eglises en béton armé", La Revue de Bourgogne, vol. 15, no. 7, 15 July 1925, p. 363.

109 Repeating an argument raised during the debate on the Champs-Elysées theater, Perret is oblivious to the fact that the posts of the theater, as well as those of industrial structures built by the Perret firm, had a square shape.

110 Mayer (see note 108), p. 364: "Ces cannelures augmentent la sveltesse de nos poteaux et précisent leur caractère. Or, le caractère est une des conditions indispensables de la beauté."

Through his experience with industrial buildings, Perret was involved in the refinement of the building elements (vaulted floors, vaulted roofs) of reinforced-concrete construction. Central to the conception of these elements was their mode of making, dependent on the crafting of the formwork. Perret understood the industrialization of modern concrete construction in terms of the prefabrication of the molds. But though the elements were conceived to be repeatable, they were exploited to produce unique, single buildings. The formworks of the Raincy church are a case in point. In the late 1920s, some writers argued that Perret had reused the formworks of the Casablanca warehouses to cast the vaults of the church.[111] This interpretation was no doubt derived from Perret's own claim regarding the use of formworks.[112] But in light of the fact that the cost of transportating the formworks from Casablanca to Paris would have outweighed the economy of the reuse, this argument can hardly be sustained. Moreover, the church vaults did not correspond in size to the warehouse vaults or to any other vaults built before the construction of the Raincy church. In fact, Perret's claim most probably inferred the reuse of formwork on the building site itself. Perret simplified the formworks to increase the speed of installation, and make their reuse easier. A comparison of the formworks of the Casablanca warehouses with those of the Esders workshop provides proof of this simplification.[113] The formworks of the Raincy church were most probably custom made, to be used for the crafting of a unique object.

The construction of the Raincy church was an important step in the development of Auguste Perret's architectural career. But if the church was in continuity with Perret's prewar developments, it was nonetheless emblematic of a doctrinal shift. With the Champs-Elysées theater, construction was embodied in the structural framework, which was merely *expressed* on the facade. In the theater, construction was clearly distinguished

[111] See Roger Ginsburger, Frankreich, die Entwicklung der neuen Ideen nach Konstruktion und Form, Vienna, Anton Schroll & Co., 1930, p. 48.
[112] A claim made in Mayer's interview of Perret published in 1925 (see note 108), p. 364.
[113] For this interpretation of Perret's conception of formworks, I am indebted to the careful observations made by Guy Lambert on the industrial architecture of the Perret firm between 1914 and the late 1920s.

from architecture by the presence of the mask. With the church at Le Raincy, Perret accentuated the dialectical relationship between construction and architecture. Construction became the fundamental basis of architecture. With the church, Perret attempted to turn construction itself into architecture.

A probable source of this doctrinal change was the industrial experience triggered by the war. Perret's renewed emphasis upon construction developed at a time when the tenets of industrial architecture were becoming increasingly influential within the realm of architecture. In industrial building, Auguste Perret and the firm focused on the refinement of the technique and form of constructional elements, and the implementation of reinforced concrete -- an industrial material -- was approached from the point of view of building craftsmanship. This approach was best exemplified by the execution of the columns at Le Raincy. Despite their standardized format, the columns were the result of a process were the formworks, the metal reinforcement, and the casting all required careful execution, and called for a sophisticated labor force. For Perret, the making process was not merely technical, it had become architectural. A conception of the relation between construction and architecture that was to be questioned by the projects and experiments of Le Corbusier.

3. Architecture and Production: Le Corbusier, reinforced concrete, and architectural aesthetics

In 1923, Le Corbusier published Vers une architecture, a manifesto which called for a global renovation of architectural thinking.[114] One of the many themes developed in the book focused on the association between modern materials and modern architecture. In this discussion, reinforced concrete emerged as the key material in the renewal of architecture. In one of his "Trois rappels à MM. les architectes", Le Corbusier wrote: "Construction in reinforced concrete has brought about a revolution in the aesthetic of

[114] Le Corbusier's Vers une architecture was first published by the Editions Crès in 1923. All quotes and page number are from the 1958 edition by Vincent, Fréal & Cie.

construction".[115] But his most compelling advocacy of modern materials came in the chapter entitled "Maisons en série". Here Le Corbusier presented the reader with a series of examples depicting the possibilities offered by reinforced-concrete construction for the realization of mass-housing.

This chapter had first appeared in L'Esprit Nouveau in December 1921.[116] Published at a time when France was still immersed in the problem of reconstruction, Le Corbusier's article addressed contemporary discussions regarding urgent housing needs. He wrote: "The program has been defined. MM. Loucheur and Bonnevay asked the Chamber to pass a law ordering the construction of 500,000 low-cost houses. It is an exceptional event in the annals of the construction industry, an event which demands exceptional means."[117] The article presented various proposals for mass-housing designed between 1915 and 1921: the Maisons Dom-ino (1915), Maisons de gros béton (1919), Maisons Monol (1919), Maisons en béton liquide (1920), and Maisons Citrohan (1921). All of Le Corbusier's mass-housing projects were explorations of the possibilities offered by reinforced-concrete construction.

Le Corbusier's discussion of mass-housing and building materials was framed by the context of industrial production. In all the branches of building construction, he contended, industry, "powerful as a natural force", tended to transform rough, natural materials and to turn them into what was called "new materials".[118] These new materials were numerous: "cements and limes, metal sections, ceramics, insulating materials,

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115 Le Corbusier (see note 114), p. 47: "La construction de béton armé a déterminé une révolution dans l'esthétique de la construction."

116 Le Corbusier-Saugnier (see note 76). For a thorough analysis of the periodical, see Roberto Gabetti, Carlo Olmo, Le Corbusier e "L'Esprit Nouveau", Turin, Einaudi, 1975 [3rd edition: 1988].

117 Le Corbusier-Saugnier (see note 76), p. 1525: "Le programme vient d'être fixé. MM. Loucheur et Bonnevay demandent à la Chambre une loi décrétant la construction de 500 000 logements à bon marché. C'est une circonstance exceptionnelle dans les annales de la construction, circonstance qui requiert égalemement des moyens exceptionnels."

118 Le Corbusier-Saugnier (see note 76), p. 1525: "En effet, dans toutes les branches du bâtiment, l'industrie, puissante comme une force naturelle, envahissante comme un fleuve qui roule à sa destinée, tend de plus en plus à transformer les matériaux bruts naturels, et à produire ce qu'on appelle des "matériaux nouveaux"."

piping, hardware, waterproof coatings, etc."[119] For Le Corbusier, industry's primary impact on construction was felt at the level of building materials:

> The first impact of the industrial evolution in the building industry manifest itself at this first stage: the replacement of natural materials by artificial materials, of heterogeneous and doubtful materials by artificial homogeneous materials, which have been tested in a laboratory and produced with fixed elements. Fixed materials must replace natural materials, which are indefinitely variable.[120]

According to his interpretation, reinforced concrete was a fixed material, securely determined by scientific calculation and industrial production.

In this same passage, Le Corbusier recalled the regionalist distinction between natural and artificial materials. For the advocates of regionalism, this distinction was instrumental in the valuation of natural materials over artificial ones. For Le Corbusier, industrial reality imposed the new artificial materials. He further distinguished between homogeneous materials and heterogeneous materials, stressing the value of tested and fixed materials. For him, metal sections and reinforced concrete were "pure manifestations of calculation, based on the exact and total use of matter."[121] Such a conception of artificial materials entailed the defeat of natural materials: "stone, good natural stone in one meter thick walls has been replaced by the light double partitions in clinker slag."[122] This passage is central to our evaluation of Le Corbusier's conception of materials and technology during the period of the reconstruction. While focusing on reinforced concrete as the key material for the reconstruction, Le Corbusier emphasized the direct connection between industrial methods and new materials. Shifting attention

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[119] Le Corbusier-Saugnier (see note 76), p. 1525: "Ils sont légion: ciments et chaux, fers profilés, céramique, matériaux isolants, tuyauterie, quincaillerie, enduits imperméables, etc."
[120] Le Corbusier-Saugnier (see note 76), p. 1530: "Les premiers effets de l'évolution industrielle dans le "bâtiment" se manifestent par cette étape primordiale: le remplacement des matériaux naturels par les matériaux artificiels, les matériaux hétérogènes et douteux par les matériaux artificiels homogènes et éprouvés par des essais de laboratoire et produits avec des éléments fixes. Le matériau fixe doit remplacer le matériau naturel, variable à l'infini."
[121] Le Corbusier-Saugnier (see note 76), p. 1530: "Par ailleurs, la loi d'Economie réclame ses droits: les fers profilés et, plus récemment, le ciment armé, sont de pures manifestations de calcul, employant la matière totalement et exactement..."
[122] Le Corbusier-Saugnier (see note 76), p. 1530: "la pierre, la bonne pierre naturelle en murs de un mètre d'épaisseur, s'est vu damer le pion par de légères cloisons doubles en scories de machefer..."

from the nature of a material to its mode of production, he moved away from the current discourse on the status of modern building materials. A retrospective examination of Le Corbusier's early thinking and experience with modern materials will shed light on this new interpretation.

Early experiences

The first evidence of the young Charles-Edouard Jeanneret's interest in materials and technique, especially reinforced concrete, can be traced back to his early professional experience in Paris in 1908. Many years later, Maximilien Gauthier narrated Jeanneret's first encounter with reinforced concrete. Gauthier recounts that it is Eugène Grasset who directed Jeanneret to the Perret brothers, giving a vivid description of the contemporary belief in the material's redemptive quality.[123] Jeanneret worked sixteen months at the office of the Perret Frères, from the end of June 1908 to early November 1909. Though he was hired on the basis of his experience as a draftsman, the exact nature of his work at the office has not yet been clearly established. Some writers have argued that Jeanneret worked specifically on the design of the *claustras* for the Oran cathedral, and on the hunting lodge La Saulot at Salbris.[124] In the letter of recommandation Jeanneret received from his former employer in 1910, Auguste Perret specified that his apprentice had worked on a number of projects based on reinforced-concrete construction that included the Oran cathedral and the warehouses of Saïda and Sidi Bel Abbès near Oran.[125] A letter written to his former professor Charles L'Eplattenier seems to reveals that Jeanneret was

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[123] Gauthier wrote: "Et pourtant si, tout peut être sauvé par la vertu d'un procédé de construction qui commence à se répendre: on fait des coffres en planches, on met des fers à l'intérieur, on emplit de béton. Des portées plus grandes réalisées déterminent de nouveaux rythmes, en plan comme en élévation. Des formes pures sont la conséquence du coffrage. Cela s'appelle le *béton armé*. Allez donc voir les frères Perret..." Maximilien Gauthier, Le Corbusier ou l'architecture au service de l'homme, Paris, Denoël, 1944, p. 27.

[124] See Fanelli, Gargiani, 1990 (see note 75), pp. 6 ff.

[125] Auguste Perret, letter to Ch.-E. Jeanneret, 27 March 1910 (Fonds Perret, 535 AP 318). Perret wrote: "Certifions que Ch. E. Jeanneret a été pendant deux ans notre collaborateur pour l'exécution d'important travaux d'Architecture et de Béton Armé tant du point de vue de la conception que de la réalisation."

not cut off from the experience of the building site.[126] The phrasing of the letter also attests that for Jeanneret, reinforced concrete was a means not merely of modernizing construction but of revolutionizing architectural forms.

According to Paul Turner, Auguste Perret's teaching was influential, leaving traces in Jeanneret's early commentaries on architecture.[127] In an annotation in his copy of Viollet-le-Duc's Dictionnaire, Jeanneret makes an analogy between the *carcasse* of Gothic architecture and that of reinforced-concrete construction.[128] This comment, Turner notes, derives directly from Perret's own interpretation of architecture. Yet Turner also adds that Perret's Rationalist "principles seem to have been grafted onto, or laid over, Jeanneret's existing idealism, rather than replacing or modifying it".[129]

But the experience of concrete construction Jeanneret acquired with the Perret brothers was apparently insufficient. In a letter to Max DuBois dated February 1910, Jeanneret discussed the possibility of deepening his knowledge of reinforced concrete with German engineers.[130] DuBois, one of Jeanneret's childhood friends, was a civil engineer involved in modern construction techniques. He had translated the book Eisenbauten Bau (1906) written by his professor Emil Mörsch, which was published in 1909 under the title Le Béton Armé.[131] Jeanneret read Mörsch's book in March 1910.[132]

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126 Jeanneret wrote: "Sur le chantier des Perret, je vois ce qu'est le béton armé, les formes révolutionnaires qu'il exige". Ch.-E. Jeanneret, letter to Charles L'Eplattenier, 22 November 1908. Quoted in Jean Petit, Le Corbusier Lui-même, Genève, 1970, p. 34.

127 Paul V. Turner, The Education of Le Corbusier, New York-London, Garland, 1977, pp. 51-53.

128 Jeanneret wrote: "Ces quelques lignes font voir que tout cet art vit par sa carcasse. C'est un monolithe aussi, une cage de fil de fer, -- où les pressions verticales et les poussées obliques tiennent lieu du ciment des blocages romains, et des ronds d'acier du béton. Or, me disait Aug Perret, tenez la carcasse, et vous tenez l'art..." Quoted in Turner (see note 127), p. 52.

129 Turner (see note 127), p. 52: "Jeanneret did indeed adopt certain specific principles of Perret's rationalism, such as an emphasis on structural systems, an a fascination for new materials and their potentias; and these were of course to shape his thinking from them on. Yet these new principles seem to have been grafted onto, or laid over, Jeanneret's existing idealism, rather than replacing or modifying it."

130 Ch.-E. Jeanneret, letter to Max DuBois, 1 February 1910. Quoted in Fanelli, Gargiani, 1990 (see note 75), p. 30.

131 On this question, see Joyce Lowman,"Corb as structural rationalist. The formative influence of the engineer Max DuBois", The Architectural Review, vol. 160, 1976, no. 956, pp. 229-233.

132 In a letter to Auguste Perret sent from La Chaux-de-Fonds, Jeanneret wrote in 1910: "Au fond, ces vacances furent studieuses puisque j'ai appris assez sérieusement le bouquin de Mörsch." Ch.-E. Jeanneret, letter to A. Perret, 26 March 1910 (Fonds Perret, 535 AP 318).

Jeanneret went to Germany from April 1910 until May 1911, attending the Werkbund Congress held in June 1910 in Berlin. At the Congress, Jeanneret was particularly attentive to the conferences of Theodor Fischer and Karl Ernst Osthaus, which focused on the thematic issue of "Materials and style".[133] Talking about the "artistic use of new materials", Fischer argued that concrete became interesting only when architects began to employ it as an art form.[134] These issues reappeared in Jeanneret's Etude sur le mouvement d'art décoratif en Allemagne published in 1912. Commenting upon the exhibition *Ton-Kalk-Cement-Industry* held during the congress, Jeanneret recalled the topic of the Werkbund conference on the relationship between art and modern materials.[135] Upon his return to La Chaux-de-Fonds in November 1911, Jeanneret opened an architectural office. Among other qualifications of his practice, his business card bore the inscription *Béton armé*.

The maison Dom-ino (1914-16)

Before the war, Jeanneret's focus on reinforced concrete was key to his architectural thinking about construction. But he still had had little chance to design a project based on the use of the material. The war gave him an occasion to explore the technical possibilities of the material in the Dom-ino project -- a frame system of reinforced-concrete construction. In his later writings, Le Corbusier presented the Dom-ino system as a "spontaneous" solution for the reconstruction of the areas destroyed at the beginning of the war in 1914.[136] Eleanor Gregh has convincingly argued that it is necessary to consider Dom-ino as both an end and a beginning, "to relate the idea to Le Corbusier's

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133 On Jeanneret and Germany, see Werner Oechslin, "Allemagne. Influences, confluences et reniements", Le Corbusier, une encyclopédie, Paris, Centre Georges Pompidou/CCI, 1987, pp. 33-39. For a competing point of view, see Rosario De Simone, Ch.E. Jeanneret- Le Corbusier Viaggio in Germania 1910-1911, Roma, Officina Edizioni, 1989, pp. 150 ff.

134 Fischer, quoted in Oechslin (see note 133), p. 35: "C'est seulement quand les architectes commencèrent à utiliser le béton comme une forme d'art qu'il devint intéressant..."

135 Charles-Edouard Jeanneret, Etude sur le mouvement d'art décoratif en Allemagne, 1912, p. 37.

136 Le Corbusier, Pierre Jeanneret, Oeuvre complète 1910-1929, (ed. by O. Stonorov, W. Boesiger), Zurich, Girsberger, 1937 [Zurich, Artemis, 1964], p. 23.

past as well as his future thinking."[137] She writes: "The Dom-ino idea was the synthesis of Jeanneret's reflections 1907-16 on the nature of architecture and the role of the architect in modern industrial society; it stated the central problem and defined the context in which it had to be solved."[138] Gregh rightly insists on the role played by the Dom-ino project in the development of Jeanneret's ideas on architecture. I shall argue that it is with this project that Jeanneret begins to articulate a different understanding of modern materials and technique.

Contemporary sources on the Dom-ino are fragmentary, but Gregh has proposed a convincing reconstruction of Jeanneret's conception and intention. The Dom-ino was based on a post and slab configuration. The frame raised on six footings was made of six standardized reinforced-concrete columns which supported the floor slabs and the stair element (fig.51). Despite its apparent simplicity, the Dom-ino system relied on a complex building process. Gregh writes: "The reinforced concrete columns are poured *in situ*. Once they have set, metal spigots are attached to each column, their function being to hold in suspension a grid of steel I-beams, formwork for the pouring of the floor slabs."[139] The floor slabs were made of hollow tiles and concrete joists, a technique which allowed the production of smooth slabs without supporting beams.[140] The technique advocated proposed to do away with traditional wooden formworks for the floors, replacing them with a system of reusable metal formworks. The standardization of the parts and the system of reusable formworks made it possible to envisage a simplification and rationalization of the building process.

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137 Eleanor Gregh, "The Dom-ino Idea", Oppositions, Winter-Spring 1979, nos. 15-16, pp. 61-87.

138 Gregh (see note 137), p. 79.

139 Gregh (see note 137), p. 62.

140 Gregh (see note 137), p. 66. On the system, Brian Brace Taylor writes: "The system which he adopted for constructing the floor slabs and supporting posts was not in itself an innovation; in his own library Jeanneret possessed a manual published by the American Portland Cement Association (1912) describing a conventional system of prefabricated, hollow tiles for floor slabs similar to that proposed by Jeanneret". B.B. Taylor, Le Corbusier at Pessac, Exh. catalogue, Harvard University, 1972, p. 3.

Despite Le Corbusier's claims regarding the industrialization of construction, the Dom-ino project does not give a clear idea on the architect's thinking about prefabrication. Did he advocate the prefabrication of building elements, or the prefabrication of formworks ? As Gregh points out, the precise technique Le Corbusier envisaged for making the frame remained ambiguous.[141] Le Corbusier always insisted that the frame (the concrete posts) was to be made without traditional formworks. In effect, one of his study drawings for the Dom-ino bears the following inscription: "Monolythe - reinforced concrete skeleton poured without formworks on six footings provided A." (fig.52).[142] Yet in her study, Gregh is compelled to conjecture that the posts were made "presumably using traditional wooden formwork."[143] According to Gregh, "both columns and slabs were to be poured *in situ*, and the only elements prefabricated were the reusable metal formwork and the various fittings inside and out".[144]

In Le Corbusier's later description of the Dom-ino house however, one can identify traces of a conception of concrete construction in terms of the prefabrication of building elements. The earliest published description of the Dom-ino frame was in the 1921 Esprit Nouveau article. The caption reads: "Rigid skeletons were delivered by a building firm on six box-like footings set at level above ground."[145] This brief description was reproduced without changes in the pages of Vers une architecture. But it is only in the first volume of the Oeuvre complète, published in German in 1929 and in French in 1937, that a more elaborate explanation of the construction method of the Dom-ino frame was given.[146] The text of the Oeuvre complète reads: "This reinforced concrete is made without formwork: it is crafted

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141 Gregh (see note 137), pp. 63-64. Gregh writes: "...the text is misleading in its suggestion that the frame was, at least in part, prefabricated ... since both columns and slabs were, in fact, to be poured *in situ* and the only elements to be prefabricated were the reusable metal formwork and the various fittings inside and out."
142 H. Allen Brooks (ed.), The Le Corbusier Archive, New York, Garland, vol. 1, p. 60: "Monolythe - ossature de béton armé coulée sans coffrage sur six points d'appui fournis A".
143 Gregh (see note 137), p. 64.
144 Gregh (see note 137), p. 63.
145 Le Corbusier-Saugnier (see note 76), p. 1528: "Des ossatures rigides étaient livrées, par une entreprise, sur six dés préalablement établis de niveau, au dessus du sol."
146 Le Corbusier, Pierre Jeanneret (see note 136), pp. 24-26.

with special equipment that permits the construction of floor slabs smooth on both faces with a simple arrangement of metallic joists... : the concrete posts are made at the building site and fixed [*dressés*] with the formwork system described above."[147] In this description, Le Corbusier's use of the term *dressé* with regard to the posts was ambiguous, for it could mean both to lift (put in place vertically) and to set up. Though the description is not absolutely clear about the way the posts were to be made, it seems to imply that they were made in molds resting on the ground and then lifted up. The description is, however, silent on the nature of the metal reinforcement needed, and on the connection between posts and footings. Despite the technical problems related to the execution of the frame, I would argue that Le Corbusier envisioned the Dom-ino as an assemblage of prefabricated elements. The idea of prefabrication is further implied by the discontinuity in the vertical posts. Interrupted by the monolithic floor slab, the posts appear to be conceived as discrete elements.

For the critics of ABC -- a Swiss architectural journal that emphasized the industrial production of housing -- Le Corbusier's Dom-ino house was without any doubt based on a prefabricated frame.[148] In the double issue on reinforced concrete published in 1925, ABC both praised and criticized Le Corbusier's exploitation of the material as it was embodied in the Dom-ino system. According to their reading, the construction of the Dom-ino posts exploited the possibilities of prefabrication.[149] The systems were modern because they reduced manual work to the operation of assembly. Yet ABC also argued that the system did not fully exploit the possibilities of the material. It remained composed of single elements, and based on the piling up and joint connection principle.[150] For the

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[147] Le Corbusier, Pierre Jeanneret (see note 136), p. 23: "Ce béton armé-là est fait sans coffrage: à vrai dire, il s'agit d'un matériel de chantier spécial qui permet de couler les planchers définitivement lisses dessus et dessous au moyen d'un très simple échafaudage de poutrelles...: les poteaux de béton sont coulés à pied d'oeuvre et dressés avec le système de coffrage ci-dessus."
[148] On ABC, see Jacques Gubler, ABC. Architettura e Avanguardia 1924-1928, Milan, 1983.
[149] ABC - Beiträge zum Bauen, vol. 1, nos. 3/4, 1925, p. 4: "Die gleich langen und gleich starken Stützen können zum Voraus angefertig werden ..."
[150] "Sie bleiben Zusammenstellungen von Einzeiteilen, sie beruhen auf dem Prinzip des Aufstapelns und Aneinanderfügens." ABC - Beiträge zum Bauen (see note 149), p. 4.

critics of ABC, the prefabricated elements of the Dom-ino were treated like large bricks, only in a more economical way.[151]

The development of the Dom-ino was a long process. It was done in collaboration with Jeanneret's friend the engineer Max DuBois and the Swiss engineer Juste Schneider.[152] Auguste Perret was also apprised of the existence of the project. In a letter to Perret dated March 1915, Jeanneret described the role played by reinforced concrete in the conception of the building system.[153] During the summer 1915, Perret's advice was directly solicited.[154] Perret thought that the system could be applied to many types of buildings, such as factories, schools, and public buildings.[155] His only comments were directed at the size of the slabs, and at the necessity of paying attention to the design of the formworks. These comments are revealing of Perret's technical understanding of the material. For Perret, the technical and economic viability of a reinforced-concrete structure was directly dependent on the making of the formwork. With the Dom-ino project, Jeanneret was thus confronted with the fundamental problem of reinforced-concrete construction in mass-housing: should the focus be placed on the prefabrication of building elements or the prefabrication of the formworks?

Jeanneret's conception of Dom-ino is further revealed by his efforts to get the system patented.[156] These efforts took place at the end of 1915 with the preparation of

151 "Die Elemente sind im Wesen nichts anderes als grosse Backsteine, sie sind allein Ökonomischer." ABC - Beiträge zum Bauen (see note 149), p. 4.
152 Gregh (see note 137), p. 66.
153 Jeanneret wrote: "Et puis j'ai cherché avec un ingénieur de Paris, un procédé de reconstruction de villages ou de petites villes. Le béton armé m'a fourni des ressources incroyables, et une variété, et une plastique passionnantes en ceci que d'elles-mêmes, mes rues s'érigeraient en un rythme de palais, d'une tranquilité pompeïenne." Ch.-E. Jeanneret, letter to Auguste Perret, 30 March 1915 (Fonds Perret, 535 AP 318).
154 Jeanneret wrote: "Je vous apporterai mon système de reconstruction en béton armé pour que vous me le critiquiez impitoyablement." Ch.-E. Jeanneret, letter to A. Perret, 3 May 1915 (Fonds Perret, 535 AP 318).
155 Jeanneret wrote: "J'ai été voir Auguste Perret dans le Midi. Je lui ai soumis mes dossiers de reconstruction. Il trouve très bien. Et il n'a pas eu à faire une objection, sauf qu'il trouve que notre procédé avec le même moule pourra faire la fabrique, l'école, les Etablissements Publics, etc. Auguste Perret trouve qu'il nous faut des dalles un peu fortes et il dit" 'votre carcasse, c'est juste une plusvalue; si on peut faire supporter par la société des prêts hypothécaires et faire que la municipalité ou le particulier ne le paient pas? voilà le problème. De même, il faut s'occuper du coffrage'." Ch.-E. Jeanneret, letter to Max DuBois, 15 June 1915. Quoted in Gregh (see note 137), p. 80.
156 These efforts are well documented in his correspondence with DuBois. Lowman (see note 131). See also Gregh (see note 137), pp. 68-71.

patent drawings and a sales brochure.[157] The patent was to be commercialized by a firm Jeanneret intended to set up in association with DuBois. From the outset, Jeanneret conceived the Dom-ino as a process which could be commercialized under the supervision of a specialized firm. The fate of the system depended on the existence of a firm capable of manufacturing and selling the frame on a large scale. The organization of the 1916 exhibition of *La Cité reconstituée* appeared as an occasion to promote the idea by building a prototype of the Dom-ino.[158] But Jeanneret's initial interest was apparently reversed by Auguste Perret's suggestion not to participate in the exhibition.[159] All efforts towards patenting the Dom-ino were finally abandoned at the end of 1916.

The villa Schwob (1916-17)

Despite Jeanneret's interest in the industrialization of construction, his approach to reinforced-concrete construction was not entirely conceived in terms of prefabrication. The design and construction of the villa Schwob (1916-17) in La Chaux-de-Fonds is a case in point.[160] In 1916, Jeanneret received the commission to build a villa for the local manufacturer Anatole Schwob. From the outset, Jeanneret opted for the use of reinforced concrete. Despite Jeanneret's claim to be a specialist in reinforced-concrete construction, the villa was his first tangible occasion to make use of the material. In the buildings erected in Switzerland until then, he had only exploited the more conventional "mixed" systems of metal beams combined with masonry construction.[161] Writing to Perret about his most recent commission -- the conception of an apartment house -- Jeanneret could

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157 The proposed patent was titled "Brevet d'invention concernant les constructions extensibles en béton armé" (FLC, E1.19.99).
158 Gregh (see note 137), pp. 70-71.
159 This comment is documented in a letter from Jeanneret to Max DuBois, 17 April 1916. Jeanneret quotes Perret as having said: "C'est l'organisation d'une petite côterie Plumet, Frantz Jourdain et Cie. Pour ce qui me concerne, je ne marche pas!...Ce sera gentillet. J'ai une maladive horreur de ces manifestations." Cited in Gregh (see note 137), p. 83. See also: Fanelli, Gargiani, 1990 (see note 75), p. 54.
160 On the design of the villa Schwob, see Jacques Gubler, "La Chaux-de-Fonds", in Le Corbusier, une encyclopédie (see note 133), pp. 222-230.
161 Gubler (see note 160), p. 229.

only repeat his desire to build in reinforced concrete despite the bad reputation the material had in the region.[162]

In a subsequent letter to Perret, Jeanneret described the source of the plan of the villa Schwob: "You recall the studies for the *maison bouteille* of 1909. The plan will follow the same principle, but the facades with terraces, *à la française*... except in reinforced concrete." [163] Jeanneret added: "It will be a concrete skeleton erected in a few weeks with an infill of nice visible bricks."[164] The reinforced-concrete frame of the villa -- the posts and ribbed floor slabs -- was calculated by an engineering firm from Zurich. The house's structure was based on a group of sixteen square posts 25 centimeters wide. Jeanneret was ambiguous regarding the expressive the role to be given to the structural framework. While four concrete posts defined the geometry of the living room, most of the other posts were buried within the thickness of the walls (fig.53). The same is true of the structural beams. In the two semicircular rooms, the exposed beams create a pattern on the ceiling. But while one of the beams is part of the structural framework, the others are fake.[165]

According to Gubler, the villa Schwob shows how Jeanneret had profited from the teaching of Auguste Perret, especially in the coincidence of the vertical structure with the geometry of the plan, and the opposition between the structure and the brick infill.[166] That Auguste Perret was a key point of reference during the 1910s is confirmed by the sizeable correspondence Jeanneret sent him between 1910 and 1918. The design of the villa Schwob shows that in 1916, Jeanneret was still largely indebted to Perret when confronted with the implementation of reinforced concrete in domestic architecture. But it

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162 Ch.-E. Jeanneret, letter to Auguste Perret, 14 June 1916 (Fonds Perret, 535 AP 318). Jeanneret wrote: "C'est en béton armé que je ferai cet immeuble. Or ici le béton jouit d'une mauvaise presse."

163 Ch.-E. Jeanneret, letter to Auguste Perret, 21 July 1916 (Fonds Perret, 535 AP 318): "Vous vous souvenez des études de la 'maison bouteille' en 1909. Ce sera un peu le principe du plan, mais les façades avec terrasses, et 'à la française'... mais béton armé."

164 Jeanneret (see note 163): "Ce sera l'ossature béton montée en quelques semaines et le remplissage en jolies briques apparentes."

165 On this reading of the structure, see Fanelli, Gargiani, 1990 (see note 75), p. 58.

166 Gubler (see note 160), p. 230.

also reveals Jeanneret's ambivalent approach regarding the aesthetic role of the structural frame. In 1916, the industrialized post-and-slab frame projected for the Dom-ino project could coexist with the traditional post-and-beam structure of the villa Schwob. At the beginning of the 1920s, Jeanneret was gradually to reject both Perret's teachings and his conception of reinforced-concrete construction.

The architect as entrepreneur

Jeanneret's experience with the Dom-ino gives clear indications of his conception of modern materials and technology. This conception is further revealed by his explicit intention to engage in entrepreneurial activities. In 1915 Jeanneret had plans to set up a firm to commercialize the Dom-ino system and in 1916 attempted to convince DuBois and the Société d'Applications du Béton Armé (S.A.B.A.) of the viability of the system. In November 1916, Jeanneret was engaged as architect-consultant to the S.A.B.A., which involved him in the design of a number of projects, including workers' housing at Saintes. Shortly afterwards Jeanneret founded his own enterprise, the Société d'Entreprises Industrielles et d'Etudes (S.E.I.E.), which included both a small concrete-block factory and a research section devoted to the study of concrete and refrigeration. It is in this context that he pursued the study of prefabricated low-cost housing for the reconstruction of the devastated regions.[167] In a letter to Tony Garnier, Jeanneret spelled out his belief regarding the new role and status of the architect: "I am administrator of the S.E.I.E. because I believe that an architect should be able to be financially and technically responsible for the works he conceives".[168] Jeanneret's entrepreneurial activities were at odds with the traditional definition of the professional architect.

These combined activities of conception and production took place at a time when Jeanneret was discovering Taylorism.[169] Jeanneret probably first became familiar with

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167 McLeod (see note 23), p. 135.

168 Ch.-E. Jeanneret, letter to Tony Garnier, 14 May 1919. Published in B.B. Taylor, "Le Corbusier's Prototype Mass Housing: 1914-1928", Ph.D. dissertation, Cambridge, Harvard Univ., 1974.

169 On Le Corbusier and Taylorism, see McLeod (see note 23).

the principles of Scientific Management during the war years, when he studied extensively at the Bibliothèque Nationale. In 1917, he wrote to his Swiss friend William Ritter that he was immersed in Taylorism, but not without some ambivalence: he called it "the horrible and ineluctable life of tomorrow."[170] His understanding of Taylorism contrasted with the position of large segments of the Parisian town-planning movement. In the words of Mary McLeod: "Mass-production procedures were largely ignored. Their interests in Taylorism, like those of most French industrialists, were more psychological than technical, more concerned with theory than substance."[171]

For Jeanneret, Taylorism in architecture implied the adaptation of modern production methods to the building industry and the development of new building materials. In October 1918, he filed six patents based on the application of Everite. Everite was the French name for Eternit, a material obtained by the mixing of slow cement with asbestos fibers.[172] One of these patents was for a system of "formworks for concrete construction".[173] The plate that illustrated the patent showed a system where the formwork made in Eternit that seemed to act as a substitute for the metal armature of traditional reinforced-concrete construction (fig.54). Drawings done later showed the types of industrial building that could be achieved with the system.[174] In February 1919, Jeanneret filed another patent for a "construction system of walls with formworks".[175] The patent described a system for the constitution of a wall with thin, lightweight interlocking moulds that served as a permanent or 'lost' formwork for the walls, which were to be filled with another material, like rubble, to insure their solidity. According to Matteoni, "Jeanneret's interest in Eternit was based on the conviction that he could use

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170 Jeanneret, letter to William Ritter, 25 December 1917. Quoted in Taylor (see note 168), p. 51.
171 McLeod (see note 23), p. 137.
172 On Le Corbusier's early patents see Dario Matteoni, "The 16 patents of Le Corbusier 1918-1961", Rassegna, no. 46, June 1991, pp. 70-79. Le Corbusier's adoption of Everite could be examined in relation to Perret's use of *fibro-ciment* for a church roof in 1916 (see note 102).
173 "492.386 - *Coffrages pour constructions en ciment* - 18 octobre 1918 - Jeanneret". (I.N.P.I.)
174 Matteoni (see note 172), p. 76.
175 "496.013 - *Procédé de construction de murs par coffrage* - 19 février 1919 - Jeanneret"; "21. 671 - 1ère addition au brevet d'invention no. 496.013 - 11 septembre 1919 - Jeanneret". (I.N.P.I.)

this material as a sort of shell capable of giving the cement the desired form and of transferring onto the built elements, following an idea which had already been put forward with the Dom-ino system, the perfection of smooth shapes."[176] Le Corbusier's interest in Eternit was also due to the fact that the shell performed as a substitute for the metal reinforcement.

Le Corbusier's development of patents for the use of Eternit was largely inspired by the Eternit company's previous experiments. At the exhibition *Le Cité reconstituée*, the Société Française des Usines 'Eternit' had displayed different applications of the material in the production of houses.[177] At the same event, the Société 'L'Habitation Economique' from Geneva had exhibited a system of construction based on the use of concrete poured in Eternit molds or formworks. According to Matteoni, Le Corbusier's patents were conceived in the context of his attempt to invest in the Société Française de l'Everite.[178] For Le Corbusier, the implementation of new building methods could not be achieved without the productive capacity of a commercial organization.

For architects, the patent conventionally serves as a means to retain the ownership and economic benefit of an invention or technical improvement. For Jeanneret, it was probably conceived as a means to transform the building process itself. Jeanneret's experience with patents is revealing of a new conception of building materials, building processes, and the architectural object. The patent transformed building materials into 'technical objects'. Commenting on the prefabricated houses of the industrialist Gabriel Voisin, Jeanneret wrote: "In recent times, the science of building has evolved in a stunning way; the art of building has taken root deeply in science."[179] Elevated by the

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[176] Matteoni (see note 172), pp. 71, 74.
[177] Gaultier (see note 3), p. 105.
[178] Matteoni writes: "Jeanneret deposited the six applications in October 1918 and, as far as we can tell, it was the managing director of the Société Française de l'Everite himself....who paid for the patent registration costs." Matteoni (see note 172), p. 74.
[179] Le Corbusier-Saugnier, "Les Maisons Voisin", L'Esprit Nouveau, no. 2, Novembre 1920, p. 211: "La science de bâtir a évolué d'une manière foudroyante en ces derniers temps; l'art de bâtir a pris racine fortement dans la science." On Le Corbusier and Voisin, see Stanislaus von Moos, "Le Corbusier und Gabriel Voisin", Avantgarde und Industrie, (C. Smeenk, ed.), Delft, 1983.

ethos of industry and science, Jeanneret's understanding of the art of building was to assume a new dimension.

Jeanneret, Ozenfant, and L'Esprit Nouveau

Jeanneret's emulation of industrial practices -- production and patents -- was central to his conception of the nature and role of building materials. But these activities were never dissociated from a larger cultural endeavor. This endeavor took a new turn with the association between Jeanneret and Amédée Ozenfant, which led to the development of the Purist program, and to L'Esprit Nouveau. Ozenfant's family tradition coincided with Jeanneret's contemporary activities. Both shared a common interest in industrial modernism. Ozenfant's father was an entrepreneur in public works that used reinforced concrete extensively. Upon the father's death in 1916, the family firm was merged into the Etablissements Ozenfant-Brassart-Hennebique.[180]

Ozenfant and Jeanneret published Après le cubisme in October 1918, at the time the latter was actively engaged in the submission of his building patents.[181] In the chapter titled "Où en est la vie moderne", the authors reflected on Taylorism, industry, and the machine.[182] Architecture -- they argued -- had been saved because of the contribution of engineers and builders. They contended that "reinforced concrete, the ultimate building method, allows for the first time exact calculations; the Number, which is at the foundation of all beauty, can at last find its expression."[183] In this passage Jeanneret drew an analogy between the mathematics of the engineer and the mathematics of beauty, an association between art and calculation, and more globally between art and science,

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180 Françoise Ducros, "Ozenfant", Le Corbusier, une encyclopédie (see note 133), p. 279. See also Amédé Ozenfant, Art, Paris, Jean Budry, 1928, p. 143.

181 Ch.-E. Jeanneret, Amédée Ozenfant, Après le cubisme, Paris, Editions de Commentaires, 1918.

182 They wrote: "L'évolution actuelle du travail conduit par l'utile à la synthèse, et à l'ordre. On l'a définie 'taylorisme' et cela dans un sens péjoratif. A vrai dire, il n'était question d'autre chose que d'exploiter intelligemment les découvertes scientifiques." Ozenfant, Jeanneret (see note 181), p. 26.

183 Ozenfant, Jeanneret (see note 181), p. 28: "Le béton armé, dernière technique constructive, permet pour la première fois la réalisation rigoureuse du calcul; le Nombre, qui est la base de toute beauté, peut trouver désormais son expression."

that was key to Jeanneret's and Ozenfant's conception of artistic production. That conception was to inform the aesthetic positions of their periodical L'Esprit Nouveau.[184] In the first issue of L'Esprit Nouveau, the editors wrote: "No one denies today the aesthetic that emanates from the constructions of modern industry. More and more industrial constructions and machines are fashioned with proportions, plays of volume, and materials such that many among them are true works of art, because they embody the number, which is to say, order."[185]

At the turn of the 1920s, L'Esprit Nouveau became the privileged vehicle for the diffusion of Jeanneret's -- now Le Corbusier's -- ideas on architecture. One of the themes discussed was the relation between modern materials and modern architecture. In the fourth issue of the periodical, Le Corbusier claimed that reinforced concrete had brought about a revolution in the aesthetics of construction.[186] But it is an article published in the sixth issue that offers a full fledged discussion of the aesthetic of reinforced concrete in architecture. The article -- signed Julien Caron, Ozenfant's pseudonym -- discussed the villa Schwob (1916-17) by Le Corbusier. It can be read as an expression of both Ozenfant's and Le Corbusier's ideas on the current debate about materials and aesthetic.[187] Caron wrote:

> The aesthetic of reinforced concrete is in the period of unconsciousness; on a certain side of the barricade, that is among the engineers, where reason dominates, this aesthetic is being developed with ease (in factories, silos); on the other side, among the architects, where feeling acts, memory and the persistence of tradition befuddle and paralyze. It remains to confront the bases of architecture--volume,

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[184] On the scientism of L'Esprit Nouveau, see Françoise Will-Levaillant, "Norme et forme à travers L'esprit Nouveau", Le retour à l'ordre dans les arts plastiques et l'architecture (1919-1925), C.I.E.R.E.C.-Université de Saint-Etienne, 1975, pp. 241-276. Will-Levaillant writes: "Le but recherché par l'art - une émotion d'ordre mathématique." "L'ordre formel du tableau reposera donc sur le nombre, le calcul, la proportion, le rapport, l'harmonie." (p. 257).

[185] [Paul Dermée, et al.], "Domaine de l'Esprit nouveau", L'Esprit Nouveau, no. 1, October 1920: "Nul ne nie aujourd'hui l'esthétique qui se dégage des constructions de l'industrie moderne. De plus en plus les constructions industrielles, les machines s'établissent avec des proportions, des jeux de volumes et de matières tels que beaucoup d'entre elles sont de véritables oeuvres d'art, car elles comportent le nombre, c'est-à-dire l'ordre."

[186] Le Corbusier-Saugnier, "Trois rappels: Le plan", L'Esprit Nouveau, no. 4, January 1921.

[187] Julien Caron, "Une Villa de Le Corbusier 1916", L'Esprit Nouveau, no. 6, March 1921, pp. 679-704. [English translation: J. Ockman, "A Villa of Le Corbusier, 1916", Oppositions, nos. 15/16, Winter/Spring 1979, pp. 187-197.]

> rhythm, and modulation--with rational problem-solving techniques. Only on these bases will one attain an aesthetic.[188]

Caron stresses that "reinforced concrete has found a certain plastic expression in large industrial construction", but that it has "up to now always been considered by architects as a poor and ungracious material".[189] He is critical of the various architectural experiments conducted since the turn of the century, such as the use of ceramic 'scales', or the use of cast or tortuous forms, "under the pretext that concrete is a plastic material".[190] Making a veiled reference to the 25bis rue Franklin, Caron rejected past attempts to find a decorative expression appropriate to the material. In fact, the article sets the stage for a confrontation between Perret and Le Corbusier.[191] In a footnote, the author wrote that Perret "sacrificed himself to the 'expression of the construction' which was the style of the day". Discussing the villa Schwob, Caron exploited Perret's analogy between the concrete frame and the human skeleton:

> On the exterior, Le Corbusier has manifested his aesthetic concept of reinforced concrete. Neither impoverished nor bursting with gleaming scales, the concrete appears as a skeleton, as is most useful, as a firm armature, without any more pretension than in the human body where the bones give to the posture and the spirit the satisfactions of security and beauty.[192]

But while Perret sought to 'express the construction', Le Corbusier rejected the call to exhibit the skeleton, focusing instead on the plastic configuration of the envelope. For both Ozenfant and Le Corbusier, the fundamental aesthetic principle of reinforced-concrete construction was not grounded in the visual expression of the structure. It was grounded in a formal principle: the straight line.

> Reinforced concrete, aside from a number of other aesthetic consequences, maintains this fundamental condition of the right angle, which is a condition

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188 Caron (see note 187), p. 686 [Ockman, p. 191]
189 Caron (see note 187), p. 690 [Ockman, p. 195]
190 Caron (see note 187), p. 690 [Ockman, pp. 195-196]
191 On this question, see Fanelli, Gargiani, 1990 (see note 75), p. 93-95.
192 Caron (see note 187), p. 692 [Ockman, p. 196]

worthy of this time and worthy of satisfying the people of our time... The straight line is one of the rights of man.[193]

In L'Esprit Nouveau, both Ozenfant and Le Corbusier reaffirmed the necessity of the 'right angle' and the 'orthogonal spirit'.[194] For Le Corbusier, the aesthetic of reinforced concrete was tied to (universal) formal principles, not to the question of unmediated constructional expression.

The *Maisons en série*

The article "Maisons en série" gave further indication of Le Corbusier's new approach to materials and technology. The various projects for mass-housing, from the maison Dom-ino to the Maison Citrohan, were all demonstrations of a specific application of the possibilities of reinforced-concrete construction and the methods of industrial production.

With the *Maison en béton liquide*, Le Corbusier explored a construction process where the concrete is poured into formworks, yet without metal reinforcement, following a process akin to the molding of cast iron.[195] This building process was not new. It was largely inspired by the system developed before the war by the American entrepreneur and inventor Thomas Edison, a system often described in pre-war architectural and technical journals.[196] But Le Corbusier's most direct source was probably the system developed by the Société Française des Maisons et Constructions Moulées that was presented at the

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193 Caron (see note 187), p. 692 [Ockman, p. 196]

194 "L'angle droit", L'Esprit Nouveau, no. 18, November 1923.

195 Le Corbusier wrote: "Elles sont coulées par le haut comme on remplirait une bouteille avec du ciment liquide. La maison est construite en trois jours. Elle sort du coffrage comme une pièce de fonte." Le Corbusier-Saugnier (see note 76), p. 1528-29. Le Corbusier already referred to the concept of the *maison bouteille* in a letter to Auguste Perret dated 21 July 1916 (Fonds Perret, 535 AP 318).

196 Edison, "La maison moulée d'Edison", L'Architecture, vol. 23, no. 11, 12 March 1910, p. 97. Also: Edison, "Le bois et le ciment armé en Amérique", La Construction Moderne, 29 July 1911, p. 520; "Le béton coulé", Idem., 19 April 1914. First developed in 1906, Edison's system was later modified and applied at Santpoort in the Netherlands -- in collaboration with the architect H.P. Berlage and H. Hanna -- and in France. See Marieke C. Kuipers, "Experiments in building houses in concrete", Il Modo di costruire, Roma, Edilstampa, 1988, pp. 365-374.

1916 exhibition of *La Cité reconstituée*.[197] In his writings, Le Corbusier was not explicit about the technique of the system, insisting instead on the rapidity of the construction process in an attempt to draw an analogy between the factory and the building site.[198]

The *Maison de gros béton* explored another application of concrete construction (fig.55). Le Corbusier's description of the technique was cursory, and emphasized the use of materials found on the building site.[199] In contrast to the fluid concrete of the *Maisons en béton liquide*, this conception was based on the use of thick walls made out of gravel concrete. Le Corbusier explored a process where concrete was treated as a mass, a technique which bore a strong resemblance to the process advanced by Tony Garnier. In the text that accompanied the house designs published in La Cité industrielle, Garnier described the construction technique employed: "The materials employed are gravel concrete for the foundations and the walls, and reinforced concrete for the floors and the roof."[200] He insisted on the need to simplify the formwork both to facilitate the construction process and to achieve greater economy.[201] According to Garnier, simplicity of means would lead logically to simplicity of expression.[202] Jeanneret was well aware of Garnier's publication. In a letter to Garnier in May 1919, Le Corbusier praised Garnier for his pioneering role in the advocacy of reinforced-concrete construction: "You were the first to give your blessing to reinforced concrete. Until now, it was admitted only as a second class material. With your book, you turn it into the only suitable material of our

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197 Gaultier described the process as follow: "Le procédé exploité par cette Société consiste à mouler une maison entière comme on moulerait une pièce de bronze en coulant du béton à l'intérieur d'un moule en fonte." Gaultier (see note 3), p. 103.

198 Le Corbusier wrote: "Les chantiers seront-ils bientôt des usines ? On parle de maisons qu'on coule par le haut avec du béton liquide, en un jour, comme on remplirait une bouteille." Le Corbusier-Saugnier (see note 76), p. 1531. The analogy between the factory and the building site was previously developed by the architect André Granet (see note 29).

199 Le Corbusier wrote: "Une carrière est installée à même le terrain; le gravier est coulé avec de la chaux dans un banchage de 40 centimètres d'épaisseur; les planchers en ciment armé." Le Corbusier-Saugnier (see note 77), p. 1536.

200 Garnier (see note 55), p. 18: "Les matériaux employés sont le béton de gravier pour les fondations et les murs, et le ciment armé pour les planchers et les couvertures."

201 Garnier (see note 55), p. 18.

202 Garnier wrote: "Cette simplicité de moyens conduits logiquement à une grande simplicité d'expression dans la structure." Garnier (see note 55), p. 18.

epoch."[203] Directly inspired by Garnier's approach, Le Corbusier explored the possibilities of mass concrete construction, insisting on the aesthetic that derived from the constructional process itself.[204] The same argument was used in the description of the projects based on the Dom-ino frame.[205] With these projects for mass-housing, Le Corbusier gave precedence to the building process over the material employed, moving further away from the technique of reinforced-concrete construction advocated by Perret.

Le Corbusier's conception of modern materials and technique is best illustrated with the project for the Maison Monol (fig.56). The Maison Monol, which was depicted in the Esprit Nouveau article, was based on a shallow barrel-vault roof which rested on slender supporting columns that stand independent of the wall construction. As most observers have noted, these vaults call to mind those constructed by Perret for the Wallut warehouses in Casablanca.[206] The Monol vaults have also been related to those designed by Perret for the worker's dwelling illustrated in the same Esprit Nouveau article. But this association between the Monol and Casablanca vaults is problematic. Dwelling on the formal similarity between the vaults does not take into account their different structural nature.

The Monol house was related to a building system patented by Le Corbusier in 1919 that was based on the use of permanent formwork in Everite (fig.57).[207] The roof vaults relied upon the structural capacities of Everite corrugated sheets used as formworks to be filled by a thin layer of cement. The small vault rested on two thick lateral walls built with Everite formworks filled with rubble. The vault system thus conceived made use of cement without reinforcement. As such, the Monol roof vault was very different from

203 Ch.-E. Jeanneret, letter to Tony Garnier, 14 May 1919: "Vous êtes le premier qui avez consacré le béton armé. Jusqu'ici on avait admis ce matériau comme l'enfant pauvre. Avec votre livre vous en faites le seul matériau possible de notre époque." (FLC)

204 Le Corbusier-Saugnier (see note 76), p. 1536: "Une esthétique spéciale naît du procédé."

205 Le Corbusier wrote: "Le module unique (multiple de 4) provoquait une unité agréable dans les ensembles projetés; une esthétique surgissait du simple fait de l'application d'un procédé constructif modulaire." Le Corbusier-Saugnier (see note 76), p. 1536-37.

206 On this comparison, see Taylor (see note 140), p. 6; Fanelli, Gargiani, 1990 (see note 75), p. 96.

207 Matteoni (see note 172), pp. 75-76.

Perret's shallow vaults based on the technique of concrete reinforced with a metal armature and cast with reusable formworks. Moreover, in Perret's *maison en série* project, the reinforced-concrete vaults had a definite structural function. This quality was aptly reported in Le Corbusier's description of the project: "the floors are supported by tight vaults, thin in the proportions of an egg shell."[208] Perret's shallow structural vaults of the 1921 *maison en série* project directly derived from the floor system patented in early 1920 after the construction of the Esders workshop [209] Despite the similarities between Perret's and Le Corbusier's projects, the techniques involved were radically different. While Perret was developing the technique of reinforced-concrete construction, Le Corbusier was exploiting the possibilities of concrete cast in lost formworks. In fact, in most of his studies for mass-housing, Le Corbusier developed solutions that dispense with the design and calculation of a metal reinforcement.

Le Corbusier's imitation of the forms, but not necessarily the technique of reinforced-concrete elements is made obvious in the case of the *Maison d'artiste* dated 1922, and published in Vers une architecture. The internal shape of the roof vault of the *Maison d'artiste* seems to derive directly from Perret's parabolic roof vaults patented in 1920, and used in the Marinoni workshops.

Each of the mass-housing projects proposed by Le Corbusier was related to a specific building system. The aesthetic of the house-type was deemed to derive from the constructional process itself. But the definition of a house-type -- along with its specific aesthetic -- could also precede and condition the definition of a building system. This process of mutual definition is best illustated with the sequence of projects for the maison Citrohan. In the Esprit Nouveau article, the initial maison Citrohan (1920) project is based

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[208] Le Corbusier-Saugnier (see note 76), p. 1527: "les planchers sont supportés par des voûtes très tendues, et minces dans la proportion d'une coquille d'oeuf".

[209] "510.802 - *Perfectionnements apportés à l'établissement des planchers et des toitures en ciment armé* - 27 février 1920 - Perret Frères" (I.N.P.I.)

on longitudinal load-bearing walls supporting concrete floor slabs.[210] In the second Citrohan project (1921-22), Le Corbusier proposed an adaptation of the house-type to the reinforced-concrete frame (fig.58).[211] Describing this project in Vers une architecture, Le Corbusier wrote: "Skeleton made of reinforced concrete trusses lifted up with a winch."[212] The description of the Citrohan house given in L'Amour de l'Art was more precise.[213] This description was probably derived from the documents presented at the 1922 Salon d'Automne. The reviewer wrote: "Its skeleton is made of concrete. The concrete posts, poured on the ground, then lifted and connected with transverse beams, make it possible to do away with wooden formwork and greatly simplify the construction process."[214] According to this description, the main structural elements were to be cast in molds and hoisted in place after setting.[215] Taking up the system of prefabrication proposed for the Dom-ino house, Le Corbusier adapted the dimensions of the frame elements to a pre-existing house-type.

Despite Le Corbusier's advocacy of reinforced concrete, the *maisons en série* cannot be located so neatly in this technical category. Apart from the Dom-ino and Citrohan house, all the mass-housing projects were based on various building techniques that included poured or mass concrete. In fact, Le Corbusier was not attached to a sole building material or a unique technology. In the various projects, he mixed natural with artificial materials, heterogeneous with homogeneous materials. The reasons for this

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210 Le Corbusier wrote: "Deux seuls murs portant, en briques, pierres, parpaings, etc..., suivant les matériaux employés dans le pays; les dalles des planchers sur le même module, des lignées de chassis de fenêtres d'usines avec guichet utile sur le même module." Le Corbusier-Saugnier (see note 76), p. 1539.

211 In Vers une architecture (1923), the Citrohan II is dated 1921. In the Oeuvre complète (1929), Le Corbusier mentions only 1922, the date of its presentation at the Salon d'Automne.

212 Le Corbusier wrote: "Ossature en fermes de béton coulées à pied d'oeuvre et dressées au treuil." Le Corbusier (see note 115), p. 201.

213 Waldemar George, "IV. L'Art Urbain", L'Amour de l'Art, vol. 3, no. 11, November 1922, p. 360.

214 George (see note 213): "Son ossature est faite en béton. Les charpentes en béton, coulées à plat, redressées et reliées par des traverses, permettent d'éviter les coffrage de bois et simplifient singulièrement la construction."

215 For the critics of ABC, the Citrohan house was based on prefabricated elements molded on the building site and hoisted with a crane: "Bei diesem System wird das tragende Gerippe auf dem Bauplatz gegossen und mit der Bockwinde aufgerichtet." ABC - Beiträge zum Bauen (see note 149), p. 4.

practice could be economical (lack of metal armatures) or technological (lack of technical knowledge). It could also be architectural. Le Corbusier was interested in the technology of mass production, not in the technique of a single building material.

At this juncture, it is possible to compare Jeanneret's attitude with Perret's approach. With the various projects for mass-housing, Le Corbusier was involved in the development of building systems that, going beyond the technical specificity of a building material, implied a transformation of the building process itself. These building systems were readily architectural, containing all the parameters for the genesis of a house-type. While Perret attempted to apply architectural procedures to industrial building, Le Corbusier attempted to implement industrial building procedures in architecture. By the early 1920s, Le Corbusier's pursuit of the industrialization of reinforced-concrete construction would act as a trigger for the development of the aesthetic of the modern house.

4. Architecture, Materials and Aesthetic

By the early 1920s, the belief that reinforced concrete was to play a major role in the development of French architecture was shared by critics of varied affiliations. By that time, the Rationalist discourse had penetrated large segments of France's architectural milieu. Before the war, the Rationalist school was still engaged in the struggle against eclecticism and the Academic tradition. But after the war, the tenets of Rationalism had come to infiltrate most critical discourses on architecture. Henri-Marcel Magne's book L'Architecture, published in 1922, offers a revealing index of the integration of Rationalist rhetoric in the reading of contemporary French architecture.[216]

For Magne, the progress of nineteenth-century architecture was linked with the progress of modern construction and modern programs. Buildings making use of iron

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216 Henri-Marcel Magne, L'Architecture (in the collection "L'Art français depuis vingt ans"), Paris, F. Rieder, 1922.

and cast iron, such as Duban's Ecole des Beaux-Arts and Labrouste's Bibliothèque Nationale, and metal constructions such as Baltard's Halles centrales and Dutert's Galerie des machines are presented as the most positive accomplishment of the nineteenth century. Magne insists on the importance of Viollet-le-Duc, arguing that his most fruitful contribution had been to address the role of decoration. Viollet-le-Duc, presented as the spokesman of the modernists, was understood to have "shown that decoration must adhere to the building the way that skin adheres to the body, revealing the shape and the structure."[217]

Magne recognized the importance played by reinforced concrete during the preceding two decades, but he rejected from the outset the election of reinforced concrete as the privileged structural material of architecture, arguing instead for the variety of materials available.[218] For Magne, reinforced concrete was an ancient principle known by Roman, Byzantine, and Persian architects that was now applied with new scientific methods.[219] Adopting Anatole de Baudot's terminology, Magne distinguished between reinforced concrete and reinforced cement, but this apparent adoption of the Rationalist approach is rapidly dismissed by a subsequent comment." In reality, whether it be reinforced concrete or reinforced cement, it is not a material, as its fanatics are saying, but a highly resistant *appareil de construction*, established on the adhesion of cement to steel."[220]

Magne's comment on the question of materials is indicative of the new nature of Rationalist discourse in the early 1920s. Rejecting the classification of reinforced concrete as a building material, Magne continued the turn of the century Academic critique of the so-called Gothic rationalism. This critique had been recurrently raised during the 1900s

217 Magne (see note 216), p. 13: "[Viollet-le-Duc] a montré la nécessité que 'la décoration tienne à l'édifice comme la peau tient au corps, laissant deviner sa forme et sa charpente'."
218 Magne (see note 216), p. 14.
219 Magne wrote: "Système qui applique des méthodes scientifiques nouvelles à un principe très ancien, connu des architectes romains, byzantins, persans." H.-M. Magne (see note 216), p. 23.
220 Magne (see note 216), p. 25: "En réalité, qu'il s'agisse du béton armé ou du ciment armé, il n'y a pas un 'matériau', comme disent leurs fanatiques, mais un appareil de construction de très haute résistance, établi sur la forte adhérence du ciment à l'acier."

by the editor of L'Architecture Louis-Charles Boileau. Magne's formulation was also indebted to the Academic theoretician Alcide Vaillant, author of the Théorie de l'architecture published in 1919.[221] Magne wrote: "The use of reinforced concrete in modern buildings will accomplish the union of decoration, form, and structure, of art and science, once realized by Byzantine or Persian construction."[222] Magne's synthetic approach called for the adoption of the decorative methods developed by Byzantine artists, who adorned their structures by means of decorative revetments. The various patterns generated by the ribs of reinforced-concrete floors were viewed as appropriate decorative forms. Magne added: "The decoration is not an addition, it is the normal development of a form, the enrichment of a point determined by the construction itself."[223]

In light of this reading, it comes as no surprise that Magne was critical of the Champs-Elysées theater. The theater was considered to make progress in terms of construction, but not in terms of expression. "The marble facade was only a revival of the veneer used in Roman antiquity: the dryness of lines was not used for the frank expression of the structural method."[224] Magne's position stands in clear contrast with Auguste Perret's contemporary reading of the theater's facade, where he emphasized the need to adorn a theater with precious materials.[225]

Magne's conception of the relationship between structure and decoration also differed from the conception advocated by Anatole de Baudot, despite Magne's critique of

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221 Vaillant (see note 63), p. 144.

222 Magne (see note 216), p. 26: "L'emploi du béton armé réalisera, dans les édifices modernes, l'union entre le décor, la forme et la structure, entre l'art et la science, que réalisa jadis la construction byzantine ou persane, d'autant mieux que l'artiste et le constructeur ne feront qu'un, que l'ingénieur aura une sensibilité d'artiste et l'architecte une éducation technique..."

223 Magne (see note 216), p. 97: "Le décor, en effet, n'est pas une adjonction, c'est le développement normal d'une forme, l'enrichissement d'un point déterminé par la construction même."

224 Magne (see note 217), p. 64: "C'est ainsi que la façade de marbre n'était que la remise en honneur des placages usités dans l'antiquité romaine: la sécheresse des lignes n'avait pas pour raison l'expression franche du mode de structure."

225 Perret stated: "On revêt un théâtre de matières précieuses, comme on s'habille pour aller au spectacle ou à une réunion élégante." Jean Badovici, "Entretiens sur l'Architecture vivante", L'Architecture vivante, vol. 1, Fall-Winter 1923, p. 12.

academic dogmatism and his recognition of the architectural potential of reinforced concrete. In fact, Magne's approach appears as a tentative synthesis of Viollet-le-Duc's attention to structure and a Beaux-Arts attention to ornamentation -- more precisely, as a tentative reintegration of structural Rationalism within the realm of Beaux-Arts material eclecticism. As such, Magne's work was representative of a faction of Beaux-Arts culture concerned after the war with the new context of architectural conception and production. This position was to be challenged by the programs put forth by Auguste Perret and Le Corbusier.

Perret

By the early 1920s, Auguste Perret's doctrine had come to concentrate on the dialectical relationship between architecture and construction. With the adoption of reinforced concrete, construction was best embodied in the structural frame. Before the war, this position was embodied in the Champs-Elysées theater. In the theater, the structural framework was left bare on the lateral side and expressed in the facade, yet the construction was clearly distinguished from architecture by the presence of the mask. After the war, Perret's position was given a new dimension with the church at Le Raincy, in which Perret accentuated the dialectical relationship between construction and architecture. Construction became the fundamental basis of architecture. With the church, Perret attempted to turn construction itself into architecture.

A probable source of this change was the industrial experience triggered by the war. In industrial building Auguste Perret and his firm focused on the refinement of both technique and the form of constructional elements. The primary goal of these technical improvements was to increase the economy of formwork and the rapidity of execution. The improvements were not directed towards industrialized production. They focused instead on the logic of execution at the building site. Though technical conception could involve the repetition of elements and operations, architectural conception only focused on the production of a single building. With Perret, the implementation of a modern material such as reinforced concrete was primarily approached from the point of view of building craftmanship and traditional modes of production.

Perret's conception of architectural ornamentation derived from this dialectical relation between architecture and construction. The typological nature of a building -- utilitarian (garage) or monumental (theater) -- determined its external treatment, from ceramic to marble revetment. Despite its artificiality, reinforced concrete was still conceived in terms of the Academic distinction between noble and industrial materials. The rough-cast concrete of the Raincy church was a compromise, not a formal statement.

By the early years of the 1920s, Auguste Perret's architectural position could be securely located within the French Rationalist tradition. In his adoption of reinforced concrete, Perret could be affiliated with Anatole de Baudot and the Structural Rationalists, while in his insistence that ornament must derive from construction, he could be affiliated with Classical Rationalism. Despite similarities in their general proposals, Perret's position differed from the one defended by Henri-Marcel Magne, the point of contention revolving around the interpretation of Viollet-le-Duc's teaching on decoration. Both agreed that "the decoration must adhere to the building the way the skin adheres to the body, revealing the shape and the structure," but for Magne reinforced concrete had to be decorated, to realize a synthesis of decoration, form, and structure. Perret, on the contrary, proposed a critical separation of construction, structure, and revetment. With Perret, Rationalism in architecture was still understood in terms of the duality between reason and the visible, between the logic of construction and the visibility of materials. The architecture of Auguste Perret proposed a new reading of architectural Rationalism, it did not question the basis of its formulation.

Le Corbusier

By the early 1920s, Le Corbusier proposed the first articulate synthesis of the new means of architecture, stressing the key role devolved upon industrial production and practices. This conception, which matured during the war years, proposed a different understanding of the relationship of material and technique to architecture. For Le Corbusier, construction was a necessary condition of architecture, but construction had taken on a new meaning. The technical improvements brought about by modern industry had transformed the building process itself. Modern materials were conceived in light of science and calculation, and the building site as a laboratory. Le Corbusier's various mass-housing projects as well as his his many patents are testimonies of this new perception of modern construction as an industrial process, and thus a mere means of the production of architecture. The conventional conception of construction as the infrastructure of architecture was put in question.

Le Corbusier's approach to modern construction as an industrial process had a direct impact on his conception and use of "new materials". Challenging the traditional nineteenth-century distinction between noble and industrial materials, between natural and artificial materials, Le Corbusier approached "new materials" (especially concrete and reinforced concrete) as building products. Used in the construction of the structural frame, reinforced concrete is conceived in terms of prefabricated posts. Used in the construction of vaults and walls, poured concrete is exploited in combination with permanent formworks that are industrially produced. In nineteenth-century architecture, wood, stone, or iron existed independently of their architectural embodiment. With Le Corbusier, reinforced concrete only existed as the end result of a constructional process.

For Le Corbusier, the practice of the architect came to be metaphorically equated with the work of the entrepreneur / industrialist. Within this framework, the material basis of architecture was treated as a product that could be industrialized, shifting architectural practice from composition to experimentation and production This new attitude towards the profession and the practice of architecture was reflected in the registration of patents, an interest that was emblematic of the new technical dimension of the practice.

Le Corbusier's linking of the new architecture with the development of modern materials and modern production techniques was a true manifestation of Rationalist thinking. But Le Corbusier was more concerned with the rationalization of construction than with elevating construction to the level of architecture. Though the readability of a building's construction system was testimony of a sound architectural conception, the intentional expression of materials and structure remained a secondary issue. For both Magne and Perret, decoration was understood in terms of the anatomical metaphor: skin and internal structure. For Le Corbusier, the relationship of decoration to its structural support was considered irrelevant to a discussion of architectural aesthetics. Le Corbusier sought rationalism not in the structural form but in architecture -- a particular conception of architecture that emphasized the importance of the building process itself.

Perret vs Le Corbusier

By 1923, both Auguste Perret and Le Corbusier had each evolved a forceful position regarding the new architecture. Both considered the relation between modern materials and modern architecture to be a major issue, and regarded reinforced concrete as the key material in the renewal of architecture. Le Corbusier's adoption of reinforced concrete can be traced back securely to the influence of Auguste Perret. For more than a decade, Le Corbusier considered Perret as a mentor, but by the early 1920s Le Corbusier's appreciation of Perret had changed. Now Le Corbusier's references to Perret were more often to recognize his professional status as a builder than his architectural production. Indeed, Le Corbusier's interest in modern materials went beyond Perret's adoption of a single building material to embrace the whole question of the future industrialization of building methods.

Le Corbusier was fascinated by the role of the engineer in the world of production and construction, and it is from this point of view that he came strategically to evaluate Perret's architectural practice. Le Corbusier's 1923 comments on the Raincy church are indicative. While the facade was judged as a "banal transposition of a former aesthetic on a new constructional fact", "the section and the interior are telling of the crucial presence of the engineer in the architecture of our time".[226] Perret's innovative church was associated with the work of the engineer, the *constructeur*.[227] For Le Corbusier, it was the "impeccable and elegant anatomy" of the building which was worthy of attention, not the appearance and treatment of the building material.

Le Corbusier's praise of Perret was not without critical intent. In Vers une architecture, Le Corbusier directly addressed the tenets of Perret's architectural doctrine, rejecting any attempt to assimilate architecture with construction. He wrote: "L'ARCHITECTURE est un fait d'art, un phénomène d'émotion, en dehors des questions de construction, au delà. La Construction, c'est pour faire tenir. L'architecture, c'est pour émouvoir."[228]

By the early 1920s, reinforced concrete was firmly established as the single most important material for the modernization of architecture. While this new acceptance was due no doubt to the war and the reconstruction period, the very perception of the material had noticeably changed. Before the war, reinforced concrete was contested for its close links with industrial architecture and its signs of industrial utilitarianism. After the war, reinforced concrete came to be accepted precisely for its association with the world of industry. This circumstantial conjunction was a powerful force in establishing reinforced

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226 Le Corbusier wrote: "L'Eglise du Raincy... nous montre une anatomie impeccable et élégante. ...Si la façade de l'Eglise du Raincy n'est qu'un banal incident de transposition d'une esthétique ancienne sur un fait constructif nouveau, l'intérieur, par contre, et la coupe surtout qu'on ne voit malheureusement pas et que si peu, du reste, sauraient apprécier, l'intérieur et la coupe montrent la capitale présence de l'ingénieur dans l'architecture de notre temps." Le Corbusier, "Salon d'automne: l'architecture", L'Esprit Nouveau, no. 19, December 1923, n.p.
227 This critique took place at a time of mounting disagreements between Le Corbusier and Perret, disagreements based on aesthetic as well as more personal issues. On this question, see Fanelli, Gargiani, 1990 (see note 75), pp. 145 ff.
228 Le Corbusier (see note 114), p. 9.

concrete as a main agent of modernization amongst architects of the emerging modern movement in France. It is at this precise juncture that the germ of future dispute lay.

CHAPTER IV

REINFORCED CONCRETE AND THE DEFINITION OF A FRENCH MODERN ARCHITECTURE (1923-27)

> "C'est le titre incontestable d'Auguste Perret d'avoir crée, par déduction logique, l'architecture du béton armé."[1] [Paul Jamot]

By the early 1920s, the architects Auguste Perret and Le Corbusier had become the main protagonists of the association between modern materials and modern architecture. In the previous chapter, we have seen how both attempted to reassess the dialectical relation between architecture and construction. While Perret insisted on the continuity with prewar practices, emphasizing the role of craft production, Le Corbusier insisted on the rupture brought about by the *société machinique*, focusing instead on the idea of industrialization. Yet both Perret and Le Corbusier construed reinforced concrete as the common denominator of the new architecture.

In 1923, reinforced concrete was largely identified with the modernization of construction and the aesthetic renewal of architecture. By 1927, however, this apparent consensus had given way to two radically divergent conceptions of both building materials and architectural modernism. Central to this cleavage was the critical definition of Auguste Perret's work as the *architecture du béton armé*. A product of convergent efforts by Perret and his circle, this new architectural *genre* was based on the artistic exploitation of a French material, and rooted in the French building tradition. In this critical process, Perret and his circle were actively involved in the definition of the paradigm of French modern architecture.

Most historians have had difficulty defining the place of Perret in the history of modern architecture in France. This difficulty is largely due to the apparent contradiction between the modernity of the material employed and the classicism of the architecture.

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[1] Paul Jamot, "1905: date décisive pour l'architecture du béton armé", L'Art Vivant, 1 September 1926, p. 642.

Focusing on the French architectural debate in the 1920s, Jean-Claude Vigato interprets Perret's position as an alternative that developed in opposition to both the academic establishment and the modernist avant-garde, an alternative he calls the *troisième voie.*[2] In his pioneering study on Perret, Joseph Abram insists on the need to examine the internal logic of the architect's doctrine.[3] Abram acknowledges Perret's debt to the Beaux-Arts tradition and recognizes that his works are difficult to evaluate in light of modernist criteria. Yet he claims that it would limit our understanding of Perret to explain his position as a mediation between two approaches. Rejecting the idea of a *troisième voie* developing in response to the Beaux-Arts tradition and international modernism, Abram claims the autonomy and coherence of Perret's theory and work. In a recent monograph on Perret, Roberto Gargiani thoroughly examines the sources of Perret's theory. Shifting the focus away from the "cult of construction technique", Gargiani shows that the architect's sources were as much artistic and literary as they were architectural.[4] Yet in his desire to assess the independent significance of Perret's oeuvre, the author bypasses the problem it poses to the historiography of the modern movement.[5]

In the histories of modern architecture, mention of reinforced concrete has become a convenient way to hint at the modern status of an architecture. But this conventional reading tends to conceal the diversity and fragmentation within the contemporary perception and construal of the material and its embodiment in architecture. It tends to conceal potential distinctions between its tectonic and corporeal qualities, between its technical and national origins, and between its formal and stylistic determinations. Most histories of modern architecture fall short of examining the question of reinforced concrete in its cultural and ideological dimension. As such, they tend to neglect the

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[2] Jean-Claude Vigato, "Le jeu des modèles. Les modèles en jeu", research report, CEMPA-Ecole d'Architecture de Nancy, 1980, pp. 33 ff.

[3] Joseph Abram, "Perret et l'école du classicisme structurel (1910-1960)", 2 vols., research report, S.R.A.-Ecole d'Architecture de Nancy, 1985.

[4] Roberto Gargiani, <u>Auguste Perret, 1874-1954: Teoria e opere</u>, Milan, Electa, 1993.

[5] See Karla Britton, "The poetics of construction (review of <u>Auguste Perret, 1874-1954: Teoria e opere</u>)", <u>Design Book Review</u>, no. 35/36, Winter/Spring 1995, p. 42.

strategic role culture and ideology played in the definition of Perret's architecture and doctrine.

In this chapter, I examine the way Perret and his circle carefully constructed a definition of Perret's architecture that attempted to reconcile modern constructional means and cultural continuity. The chapter shows that the meaning ascribed to the material was not solely technical but formal, cultural, and ultimately ideological. In the first section, I examine Perret's interest in the definition of an architectural style specific to concrete construction. In the second, I investigate the role of Perret's critics in the definition of the *architecture du béton armé*. In the third section, I examine how discourses on the material did partake of a larger debate on the nature and nationality of modern architecture, showing that by 1927 Perret's reference to reinforced concrete had come to serve in the definition of an architecture at once modern and French. By then, Perret's advocacy of a specific material had shifted from the level of architectural doctrine to the level of a broader cultural strategy.

1. Perret and the *"Style du béton armé"* (1923-25)

In 1923, the young art critic Marie Dormoy wrote the first retrospective account of the architectural works of Auguste and Gustave Perret.[6] The article was published in L'Amour de l'Art, an art journal devoted to the defense of the contemporary plastic arts.[7] Though written by Dormoy, the article was carefully revised by Auguste Perret. The annotated manuscript is revealing of the way Perret wanted his architecture to be

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[6] Marie Dormoy, "A. et G. Perret", L'Amour de l'Art, vol. 4, no. 1, January 1923, pp. 409-416. In her memoirs, Dormoy remembered having met Auguste Perret in Antoine Bourdelle's atelier in 1921, where the architect was posing for his bust. Marie Dormoy, Souvenirs et portraits d'amis, Paris, 1962, p. 77.

[7] Directed by the art critics Louis Vauxcelles and Waldemar George, L'Amour de l'Art was influential in the diffusion of French modern art tamed by the post-war *retour à l'ordre*. It is the same Vauxcelles that had engaged in a polemic against Ozenfant and Le Corbusier's purism in Le Carnet de la Semaine. See G. Fanelli, R. Gargiani, Perret e Le Corbusier confronti, Roma-Bari, Laterza, 1990, pp. 139-142.

presented and understood.[8] From the outset, Dormoy framed her analysis in light of Perret's definition of architecture: "In an edifice, one should not admit a single element that only serves as an ornament; but, always aiming to achieve beautiful proportions, one must turn into an ornament all parts that are necessary to support the edifice".[9] Perret's definition was borrowed from Fénelon, a key literary figure of seventeenth century France. The choice of such a precept is indicative of Perret's belief in the necessity of modern artistic practices being grounded in tradition. For Dormoy, this connection with tradition was best expressed in Perret's use of the term *constructeur* [builder] to qualify his professional practice -- even despite the fact that this title was at times belittled by representatives of the architectural establishment.[10]

According to Dormoy, the architecture of the Perrets was informed by their study of the history of architecture and its most important monuments. Dormoy's retrospective reading of architectural developments was largely inspired by the Rationalist interpretation of architecture developed by Viollet-le-Duc and rephrased by Auguste Choisy. Positing the lintel and the vault as the two key principles that informed the production of architecture, she identified the Parthenon and Santa Sofia as the two key architectural monuments. The vault had given birth to the Gothic arch, and to the high achievements of French Gothic architecture. The Renaissance had followed, dismissed as a period of decadence, and excepting a few masterpieces, the seventeenth and eighteenth centuries did not make much progress. With the arrival of iron, the nineteenth century was full of promise, but the century's major architectural achievements were limited to a

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[8] The Perret Archive at IFA contains a few annotated fragments and manuscripts of the articles written by Marie Dormoy during the 1920s (Fonds Perret, 535 AP 359).

[9] Dormoy (see note 6), p. 409: "Il ne faut admettre dans un édifice aucune partie destinée au seul ornement; mais, visant toujours aux belles proportions, on doit tourner en ornements toutes les parties nécessaires à un édifice."

[10] See Albert Louvet, "Les églises modernes. L'église Notre-Dame du Raincy, par MM. Perret, constructeurs", L'Architecture, vol. 37, no. 19, 1924, pp. 263-270.

few monuments, among them the Bibliothèque Nationale, the Galerie des Machines, and the Palais des Arts Libéraux of the 1889 exhibition.[11]

This passage is particularly revealing about Perret's interpretation of the historical role of iron architecture. In the original version, Dormoy had written that nineteenth-century "attempts at metal architecture, a precarious material, scrawny, costly to keep up, could not seduce the mind of the Perrets, trained by the Gothics and the Greeks."[12] Crossed out by Perret, this passage was replaced by the names of a few nineteenth century works, and by a critique of the use of exposed iron in architecture. The modified text read: "But exposed iron has a precarious existence, it demands constant and costly maintenance. Its use in monumental works is fated to disappear, and most certainly because its substitute, reinforced concrete, assumes each day a more important place."[13]

Perret's critique of iron was largely indebted to Anatole de Baudot's Darwinian reading of building materials, which set the stage for Dormoy's apology for the essential modern material: reinforced concrete. "A. and G. Perret adopted this material, considering it the only one capable of triggering the development of a new architecture, because it is not form which subjugates matter, it is from matter that form emerges."[14] For Dormoy, Perret's adoption of reinforced concrete was motivated by architectural, not technical considerations. In a strategic re-interpretation of the course of events, the author located the material as the starting point of the Perrets' architectural endeavor. According

[11] These 19th century-buildings were mentionned in Sébastien Voirol's 1914 article in Montjoie! (vol. 2, no. 4-5-6), and in one of Perret's letters to Le Corbusier. (Auguste Perret, letter to Ch.-E. Jeanneret, 17 January 1916; FLC, F2.13.157; and IFA, Fonds Perret, 535 AP 318).

[12] Marie Dormoy, annotated manuscript (Fonds Perret, 535 AP 359): "et ce ne sont pas les tentatives d'architecture en métal, matière précaire, squelettique, d'un entretien ruineux qui pouvait séduire des esprits formés à tel point par les gothiques et les grecs..."

[13] Perret wrote: "Mais le fer apparent a une existence précaire, il exige un entretien constant et coûteux. Son emploi dans les oeuvres monumentales est donc appelé à disparaître, et d'autant plus sûrement que son redoutable remplacant, le béton de ciment armé, prend une place chaque jour prépondérante." Dormoy (see note 12).

[14] Dormoy (see note 6), p. 411: "A. et G. Perret adoptèrent ce matériau, le considérant comme celui qui nous doterait d'une nouvelle architecture, car ce n'est pas la forme qui asservit la matière, mais c'est bien de la matière que jaillit la forme."

to this viewpoint, reinforced-concrete construction was taken to be the common denominator of their architecture -- a reading subtly induced by Perret himself.

Dormoy's account of the architects' early realizations focused on the use of materials, and the expression of structure. The apartment building at 25bis rue Franklin is a case in point. With its revetment of glazed earthenware conceived following the fashion of the Nancy school, Dormoy viewed the building as largely outdated, redeemed only by the clarity of its structural expression. Perret corrected the passage that faulted the ornamentation, writing instead that the revetment bore the mark of its time, and that the ornamentation did not alter the structural parts, a correction that betrays Perret's sensitivity about the building's revetment.[15] The rue de Ponthieu garage was praised for its facade, the result of a search for structural proportions. But for Dormoy, Perret's real achievement was the Champs-Elysées theater. In this building, the use of reinforced concrete allowed the creation of new forms, both inside and outside. Focusing on the facade treatment, Dormoy argued that the choice of a revetment was motivated by the fact that while the theater was a luxury building, reinforced concrete was then perceived as a meager material. It prompted the architects to veil their facade with a marble revetment which acted as a light skin through which the building's skeleton remained clearly visible.

After a review of the Casablanca warehouses, the Esders workshop, the Raincy church, Dormoy concluded with a note on the prospects for architecture opened up by the post-war period. Highly critical of the regionalist approach advocated by many for the reconstruction of the North of France, Dormoy believed that the use of reinforced concrete should and would put an end to the belief in an architecture based on regional characteristics. She confidently wrote: "The strength and economy of reinforced concrete turns it into a universal material and will create a universal style".[16] This advocacy of a

[15] Perret's annotation, in Dormoy (see note 12): "Quoique ce revêtement porte la marque de l'époque où il fut exécuté, il faut remarquer qu'aucune ornementation n'altère les parties portantes."
[16] Dormoy (see note 6), p. 416: "La puissance, et par là, l'économie du béton armé le rendra universel et créera un style universel."

universal style stood in an openly sharp contrast with the current tendency toward a nationalist *retour à l'ordre* in the arts after a pre-war period that was increasingly identified with cosmopolitanism and disorder.[17] For Dormoy as for Perret, the new material was securely posited as one of the key sources of a new architectural trend that -- like the uniform styles of great periods -- was to develop beyond local climates and borders. In France in the early 1920s, the stylistic potential of reinforced-concrete construction was best highlighted in the church that Auguste Perret and the Perret firm had just built at Le Raincy (1922-23). The critical reception of this work was to play a crucial role in the strategic positioning of Perret on the French architectural scene.

The reception of the Raincy church

The church at Le Raincy received widespread critical attention and was much praised by advocates of the renewal of religious art and architecture in France.[18] While its reception was generally positive, many hailed the church as the starting point of a new architectural style. Chief among those was Paul Jamot, writing in the Gazette des Beaux-Arts.[19] Jamot was familiar with Perret's work, having previously written an influential review of the Champs-Elysées theater. The church, Jamot wrote, "has the value of a scientific demonstration: it is the enactment, without compromise, of a construction theorem the solution of which is particularly important for the times we are in".[20] From the outset, the modernity of Perret's design was understood in terms of science and construction. But for Jamot, the church's real achievement lay elsewhere: for while it was entirely new in conception, plan, and appearance, it did not break in any substantial way with the long tradition of the Christian temple. Jamot insisted on the importance of the national

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[17] On the *retour à l'ordre* in the arts, see Kenneth E. Silver, Esprit de Corps: The Art of the Parisian Avant-Garde and the First World War, 1914-1925, Princeton, Princeton Univ. Press, 1989.

[18] Among them were Father Abel Fabre and Raymond Regamey.

[19] Paul Jamot, "Notre-Dame du Raincy", Gazette des Beaux-Arts, vol. 65, September-October 1923, pp. 199-210.

[20] Jamot (see note 19), p. 199: "L'Eglise... a la valeur d'une démonstration scientifique: c'est la mise en acte, sans compromis, d'un théorème de construction dont la solution nous importe particulièrement, à l'heure où nous sommes."

tradition. He found it appropriate to call the Raincy church the *Sainte-Chapelle du béton armé*, making reference to the thirteenth-century Paris church and establishing a direct connection between reinforced concrete and to both the verticality and luminous quality of Gothic architecture.[21] Jamot's evocation of science hinted at the mathematical rationality of the church design. But this rationality was tied to a deeper commitment to the formal tradition. Jamot's mathematical theorem had more to do with current ideas of proportion and composition than with the calculations of the engineer.[22] For Jamot, it was the merging of innovation and tradition that was at the basis of a true work of "modern" art.

This reading of the church was shared by other critics. Writing in Art et Décoration, Yvanhoé Rambosson also approached the church as an original project, convinced that it would soon be viewed as a point of departure for a new era.[23] For Rambosson, the Raincy church called for a comparison with the church of St-Jean-de-Montmartre by Anatole de Baudot. But while de Baudot's achievement was undermined due to the architect's uncertain taste, Perret's church was deemed to propose a more compelling example of the transformations that could be achieved by the logical use of new materials.[24] For Rambosson, the church was the end result of a long process begun by the master builders of the Middle Ages, enabling the Perrets to both connect with the tradition and pursue it with great audacity.

This positive reception of the church was in sharp contrast with the reception accorded the Champs-Elysées theater, ten years earlier. At the time of its inauguration, the theater was criticized by many as a manifestation of foreign influences, most notably German, accusations that reflected the nationalist reaction to the impact of the German

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21 Jamot wrote: "On a dit -- et il faut le redire, parce que c'est la vérité -- que l'église du Raincy est la Sainte-Chapelle du béton armé. Avec des moyens différents, et en tenant compte des restrictions qu'imposaient la modicité des ressources, c'est la même idée qui inspire, qui ordonne les deux constructions..." Jamot (see note 19), p. 203.

22 The importance of numbers and mathematics was stressed in Paul Valéry's Eupalinos (1921), as well as in Louis Süe and Léandre Vaillat's Rythme de l'architecture (1923).

23 Yvanhoé Rambosson, "La nouvelle église du Raincy", Art et Décoration, January 1924, pp. 1-7.

24 Rambosson (see note 23), p. 1.

decorative arts on the Parisian scene.[25] This controversy was obviously fueled by the war. The equation of new artistic expressions with Germanic art had prompted the reaction of many artists and critics in defense of modern art.[26] In the first issue of L'Art français moderne, Raymond Koechlin had taken pains to defend French art against accusation of German influence.[27] As a founder and animator of the *Art et Liberté* group, an "association for the affirmation and diffusion of modern works", Auguste Perret himself had actively taken part in the support of modern art.[28] After the war, the debate had not completely died down. In the 1919 issue of Le Béton Armé, the new editor shared the view that before the war, French architecture had succumbed to the influence of German art, and suggested that in satisfying the demands of the reconstruction there could be a return to the practice of good "architectural manner".[29] In 1919, Emile Bayard did not hesitate to write that the Champs-Elysées theater was a mistake, a "theater that looked like a necropolis".[30] But he also added that if the theater had been seen as a building tainted by German influences, it was because any original research was too often condemned as being *boche* [German]. Perret's Champs-Elysées theater had thus become an object of contention in the debate on the Frenchness of French art. The critical reception of the Raincy church helped reaffirm Perret's attachment to the French tradition.

Jamot and Rambosson hailed the Raincy church as an achievement of historic dimensions, placing it firmly in continuity with the French architectural tradition. This positive reception could possibly be attributed to friendship, for both Jamot and

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[25] On this question, see Nancy J. Troy, Modernism and the Decorative arts in France. Art Nouveau to Le Corbusier, New Haven and London, Yale Univ. Press, 1991.

[26] On this question, see Silver (see note 17).

[27] Raymond Koechlin, vice-president of the Union Centrale des Arts Décoratifs, was president of the newly founded *Société de l'art français moderne*, whose goal was the defence of French art. R. Koechlin, "L'art français moderne n'est pas 'Munichois'", L'Art français moderne, no. 1, January 1916, pp. 1-37.

[28] On the group *Art et Liberté*, see Fanelli, Gargiani (see note 7), pp. 79-83.

[29] [Editor], "Notre nouveau programme", Le Béton Armé, no. 1, 25 March 1919, pp. 1-2; [Engineer], "Le Béton Armé après la guerre", Le Béton Armé, no. 1, 25 March 1919, pp. 2-4.

[30] Bayard was inspector at the Ministère des Beaux-Arts. Emile Bayard, Le Style Moderne (in the collection "L'Art de reconnaître les styles"), Paris, Garnier, 1919, p. 146.

Rambosson had been acquainted with Auguste Perret for many years.[31] In their writing they acted not only as critics but as advocates of Perret's work. The same cannot be said of the critics attached to the architectural press, but their reception of the church was nonetheless largely positive.

Most telling was the review by Pol Abraham, the new editor of L'Architecte.[32] For Abraham, the construction of the church was an event of historic importance comparable to the realization of the Bibliothèque Nationale by Henri Labrouste -- the true source of "a new aesthetic".[33] Like Jamot and Rambosson, Abraham made reference to French Gothic architecture of the twelfth century. Yet for him, the use of reinforced concrete provoked a true development upon Gothic architecture, producing a support system sought for but never achieved by medieval builders.[34] For the anonymous reviewer of La Construction Moderne, the Raincy church was also an audacious attempt to develop an architectural style out of reinforced-concrete construction.[35] In its capacity to bridge novelty and a respect for tradition, the church was considered an important accomplishment.

One of the few negative reviews came from the Beaux-Arts architect Albert Louvet in L'Architecture, the journal of the Société Centrale des Architectes.[36] A representative

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31 In 1913, Paul Jamot - curator at the Musée du Louvre - wrote an article on the Champs-Elysées theater. Perret realized two projects for Jamot: the remodeling of his villa (1912) and the design of a funerary monument for the Jamot family at the Montparnasse cemetery (1914-21). In 1905 the critic Yvanhoé Rambosson published an article on the 25bis rue Franklin. During those years, Perret carried out the alteration of two buildings for Rambosson: his hôtel particulier (1905) and the Conservatoire Renée Maubel (1912-13). During the war, Perret and Rambosson were both members of the group Art et Liberté. In 1923, they were founding members of the Groupe des Architectes modernes.

32 Pol Abraham, "Une église en béton armé; Notre-Dame du Raincy - A. et G. Perret, architectes et constructeurs", L'Architecte, vol. 1, January 1924, pp. 13-16. The review L'Architecte (semi-official organ of the society of graduates of the Ecole des Beaux-Arts) reappeared in a new format in 1924, ten years after its publication had been interrupted by the war.

33 Abraham wrote: "Peut-être faut-il remonter à la construction de la grande salle de lecture de la Bibliothèque nationale, par Henri Labrouste, pour trouver, dans l'histoire de l'architecture française, un fait d'importance comparable à la construction de l'église du Raincy par MM. A. et G. Perret." Abraham, (see note 32), p. 13.

34 Abraham wrote: "La forme des voûtes s'est donc modifiée; les organes de butée, inutiles, ont disparu; les points d'appui, libres de leurs étais, ont enfin l'éloquence pressentie, mais jamais atteinte par les constructeurs médiévaux ..." Abraham, (see note 32), p. 14.

35 [Anonymous], "Une église en béton armé", La Construction Moderne, vol. 39, no. 22, 2 March 1924, pp. 254-256.

36 A. Louvet, "Les églises modernes. L'église Notre-Dame du Raincy, par MM. Perret, constructeurs", L'Architecture, vol. 37, no. 19, 1924, pp. 263-270.

of the architectural establishment, Louvet was critical of the Perrets' double status as architects and builders, a dual practice that ran against the rules of the profession.[37] Consequently, Louvet admired the church as a construction, but stressed that the building was much less interesting from an artistic point of view.

The problematic status of the material

Most critics focused on the choice and treatment of reinforced concrete as the single material of the Raincy church. For Jamot, the adoption of reinforced concrete was a logical choice. Available everywhere, the material possessed many qualities: it was cheap, solid, ductile. Its only defect was that it did not have the richness and the beauty of traditional materials like marble or stone. Discussing the treatment of surfaces, Jamot wrote: "At Raincy, the bare concrete played the role of a noble material. Outside as well as inside, it was visible, in its rough state."[38] For Jamot, who upheld the Academic distinction between vulgar and noble materials, the rough concrete was deemed acceptable chiefly due to the commission's economic constraint.[39] Comparing the Raincy church with the churches of Brittany built in granite, Jamot drew an analogy between the roughness of granite and the roughness of concrete. In the case of the Raincy church, the critic was willing to temporarily upgrade the status of concrete rather than break with the Academic valuation of building materials.

For all the reviewers, the provocative adoption of bare concrete required thoughtful explanation. On this critical issue, Abraham argued that the choice of reinforced concrete as the sole material of the building and the absence of revetment was not the result of an a

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[37] This double status was however praised by Father Abel Fabre, who saw this practice as a healthy return to the Romano-Gothic tradition. A militant for the renewal of religious architecture, Fabre, who also wrote under the pseudonym of Fulcran, was an advocate of reinforced-concrete construction. Fulcran, "L'église du Raincy", La Croix, 7 September 1922.

[38] Jamot (see note 19), p. 202: "Au Raincy, le béton nu joue le rôle d'une matière noble. A l'extérieur comme à l'intérieur, il est apparent, à l'état brut."

[39] Jamot wrote: "Ne croyons pas, d'ailleurs, que par un respect fétichiste pour un produit incomparablement résistant et docile, les Frères Perret s'interdisent de l'orner, de l'embellir." Jamot (see note 19), p. 202.

priori intention, no indication "of a taste for a material that has an unpleasant and poor appearance", but was, again, a solution demanded by the principle of economy.[40] For the anonymous reviewer of La Construction Moderne, the bare concrete could have been enhanced with a finish that would have enriched its appearance.[41] But he also maintained that with the church the Perrets had managed to prove that reinforced concrete possessed in itself the decorative resources to be presented bare, as long as the style adopted was in accordance with the matter. For these critics, the use of bare concrete was perceived more as an acceptable solution motivated by circumstance than as an actual architectural statement. The only writer who strongly rejected Perret's solution was the reviewer of L'Architecture. Disconcerted by the use of bare concrete, Louvet called for the use of mosaic incrustations or other revetment that would provide for inexpensive but "attractive decorative effects".[42] That Perret's adoption of bare concrete was defended as circumstantial is symptomatic of the current conception of building materials. Reviewers, concerned by the church's decorative treatment, had a hard time freeing themselves from the Academic distinction between vulgar and noble materials. The critical reception of the church's bare concrete was thus framed by the conventional conception of decoration as being dependent on the nature of the materials employed.

The construction of the Raincy church also drew the attention of the engineering press, whose discussion of the new church took place in the pages of Le Génie Civil, the venerable journal of French industry and engineering. Despite the nature of the publication, the authors were deeply concerned with the building's aesthetics. In a review published at the time of the inauguration of the church, Charles Dantin wrote that the task of the program was to achieve simplicity and majesty with very limited funds.[43]

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40 Abraham (see note 32), p. 15: "d'un goût exclusif pour une matière dont l'apparence est peu agréable et pauvre."
41 La Construction Moderne (see note 35), p. 256.
42 Louvet (see note 36), p. 270.
43 Charles Dantin, "Constuctions civiles. L'église en béton armé du Raincy", Le Génie Civil, vol. 43, tome 83, no. 1, 7 July 1923, pp. 1-4.

Reinforced concrete was the only material suited for such a task. He further added that cost constraints prevented any attempt to adorn the concrete framework with rich materials like marble, or to coat it with stucco or smooth mortar.[44] Economics lay at the source of the new style created by the Perret's, "the style of molded reinforced concrete, naked as the stones of antique monuments", at once light and harmonious.[45]

The most elaborate discussion of the aesthetic of reinforced-concrete constructions was by the engineer Léon Petit.[46] In a long preamble, Petit discussed the dual nature of a material that shared the characteristics of masonry and metal construction, recalling turn-of-the-century debates on the technical nature of reinforced concrete. "Honesty" being for the author a key principle of the art of building, Petit argued for the neeed to lay bare the material's mode of production: the molding. Putting forth an unusual argument for an engineer, Petit assimilated the technique of molding with the structural principle of monolithism, emphasizing the formal rather than the structural meaning of the term.[47] He further added that the monolithism of reinforced concrete was best achieved with simple forms: with planes and straight lines.[48] Taking the Raincy church as an example, Petit argued that with the use of reinforced concrete, the Perrets had broken from the pastiche of ancient styles to realize a building of a totally new character.[49] He predicted that the Raincy church was to become like the twelfth-century church of Morienval: the first manifestation of a newborn style. For the reviewers of Le Génie Civil, the crafting

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[44] Dantin wrote: "Seul, le béton armé pouvait fournir la solution de ce problème, et encore fallait-il qu'il fût traité de façon spéciale, puisqu'à la grande économie indispensable devait s'allier l'aspect architectural et monumental. Il fut donc impossible de songer à revêtir une ossature de béton de matériaux riches comme le marbre, ni même de l'enduire de stuc ou simplement de mortier lissé." Dantin (see note 43), p. 1.

[45] Dantin (see note 43), p. 1: "[le style] du béton armé moulé, aussi nu que la pierre des monuments antiques."

[46] Léon Petit, "L'esthétique dans les constructions en béton armé", Le Génie Civil, vol. 43, tome 83, no. 24, 15 December 1923, pp. 585-586.

[47] Petit wrote: "En tout cas, le monolithisme, l'aspect moulé du béton étant parmi ses caractères essentiels, puisqu'ils résultent de la nature même de ce matériau et du procédé de sa mise en oeuvre, il importe de ne le dissimuler en rien." Petit (see note 46), p. 585.

[48] Petit wrote: "Ce monolithisme du béton ne peut évidemment s'accomoder que des formes simples: peu de surfaces courbes, malaisément réalisables; des plans, des lignes droites; une mouluration sobre, mais très nette, tendant à la recherche des accents d'ombre." Petit (see note 46), p. 585.

[49] Petit (see note 46), p. 586.

technique -- the molding -- was a key determinant of the form. Unlike art and architecture critics, both engineers approached bare concrete as a positive outcome of the material's mode of execution. For them as for other critics, Perret's Raincy church was deemed an important moment in the development of a new architectural style.

Perret and the competition between steel and reinforced concrete

The reception of the Raincy church was influential in placing reinforced concrete at the center of the debate on the renewal of French architecture. Perret shared with the emerging avant-garde the idea that this single building material was to be the common denominator of a novel architecture. But this shared belief was rooted in different building practices. For the younger protagonists of the new architecture, mostly involved in the conception of studios and houses, reinforced concrete was viewed as a potential alternative to traditional masonry construction.[50] For Auguste Perret, who was involved in projects of a larger scale, reinforced concrete was conceived rather as an alternative to the competing structural system of steel construction. As an entrepreneur specialized in reinforced-concrete construction, Perret was naturally inclined to defend the superiority of his elected material. As an architect, Perret was eager to justify this choice at the level of architectural doctrine. This dual commitment shaped his discourse on modern construction.

Perret's conception of materials was rooted in the pre-war Rationalist reading of French architectural developments that posited nineteenth-century iron architecture as the predecessor of twentieth-century concrete architecture. Before the war Perret's position had been phrased in the context of the debate that followed the completion of the Champs-Elysées theater. By 1918, this rationalist interpretation had become commonplace, and pervaded the writings of authors of competing allegiances. The main variation,post-war, was in the interpretation of the transition from iron to reinforced

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[50] This issue is discussed at length in chapter V.

concrete, with some writers insisting on the importance of aesthetic considerations while others focused on technical issues. Perret explained this transition by the precariousness of iron, logically replaced by the more efficient material of reinforced concrete.[51]

By the early 1920s, steel had largely supplanted the use of iron in metal construction, a technical development that challenged the argument that iron would be superseded by reinforced concrete. In light of this advance in metal construction, Perret was compelled to adapt his position, and modern construction was now framed in terms of the competition between the two modern building materials: steel and reinforced concrete. His 1922 reading of the American skyscraper is a case in point. In a discussion of the tall buildings of the modern city, Perret expressed skepticism about the future of the steel skeleton. He confidently argued that the improvement of reinforced-concrete construction made possible by the development of a new type of cement -- called *ciment électrique* -- was to trigger the disappearance of the steel skeleton.[52] Developed during the war by a French engineer, *ciment électrique* was a true French material.[53]

Despite the challenge posed by this technological development, Perret believed in the dominance of reinforced-concrete construction, as his comments at the time of Gustave Eiffel's death revealed. Speaking of Eiffel's iron architecture, Perret wrote, "It is difficult to forecast the future of the great steel constructions, because the matter and the means of assembly used are precarious: metal rusts and the rivet disintegrates; but everything is changing and a new invention (oxy-acetylene welding for example) might restore to iron its dominant position, usurped by reinforced concrete."[54] In Perret's

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51 See the discussion on Perret's annotation of Marie Dormoy's article.

52 Perret was quoted as saying: "Depuis les derniers buildings américains, la technique s'est même assouplie par l'invention de matériaux nouveaux. Les 23.500 tonnes de charpente d'acier Martin d'un édifice tel que le Woolworth disparaîtront, logiquement, devant le béton (armé et fretté) au ciment électrique." Jean Labadié, "Les cathédrales de la cité moderne", L'Illustration, vol. 80, no. 4145, 12 August 1922, pp. 131-135.

53 See Perret's interview in "Le Logis", La Revue Française, 23 December 1925.

54 Auguste Perret, "L'oeuvre d'Eiffel et l'architecture du fer", Bulletin de la Vie Artistique, vol. 5, no. 6, 15 March 1924, p. 130: "Il est bien difficile de prévoir l'avenir de la grande construction en acier, parce que la matière et le moyen d'assemblage employés sont précaires: le métal rouille et le rivet soumis à un travail excessif saute; mais tout se transforme et une invention nouvelle (la soudure autogène par exemple) rendra peut-être au fer la prépondérance que lui a ravie le béton armé."

rhetoric, the possible salvation of iron construction merely served to underline the perceived weaknesses of this mode of construction. This construal of contemporary construction techniques as a battle between modern materials was not shared by all architects. Commenting on Eiffel's work, Frantz Jourdain adopted a more conciliatory viewpoint. "Iron", Jourdain wrote, "possesses its own formula, language, and code, and I don't see why it should disappear. The futile antagonism between iron and reinforced concrete should not exist, because each material plays a distinct role in construction, and if the industry brings us tomorrow a new element, we will have to adopt it without rejecting the work of our predecessors." [55] As the main designer of the Samaritaine store, a masterpiece of metal architecture erected in 1905, Jourdain's defence of iron was perhaps not purely a matter of principle. But his comment highlights the doctrinal character of Perret's discourse.

A Beaux-Arts trained architect, Perret was equally an entrepreneur and specialist in reinforced-concrete construction, and the apparent neutrality of the building specialist often served to conceal the doctrinal convictions of the architect.[56] Invited to give a lecture on reinforced concrete in 1924, Perret could not help but contrast the *matériau moderne par excellence* with iron and stone, qualified as "old materials".[57] Immersed in the activities and practice of a building firm, Perret was obviously well informed of recent technical developments in the field of construction. He was aware of current improvements in the construction of the metal skeleton brought about by new welding methods, like oxy-acetylene and electric welding. Yet because of his doctrinal

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[55] Jourdain wrote: "Le fer possède sa formule propre, son langage et son code, et je ne vois pas pourquoi il disparaîtrait. L'antagonisme un peu puéril entre lui et le ciment armé n'a aucune raison d'être, car chaque matériau joue un rôle distinct dans la construction, et si l'industrie nous apporte demain un élément nouveau, il faudra l'adopter avec joie sans, pour cela, jeter l'anathème sur ce qu'ont fait nos prédécesseurs." Frantz Jourdain, cited in "L'oeuvre d'Eiffel et l'architecture du fer", Bulletin de la Vie Artistique, vol. 5, no. 2, 15 January 1924, pp. 41-42.

[56] Perret's positive assessment of his Beaux-Arts training was confirmed by his annotation of Dormoy's 1923 article. It is Perret who added the passage that reads: "Ils firent un rapide et brillant passage à l'Ecole des Beaux-Arts". Dormoy (see note 12).

[57] Auguste Perret, "Conférence sur le béton armé", conference at the Ecole des Arts industriels, Grenoble, 3 May 1924, typed manuscript, 8 pp. (Fonds Perret, 535 AP 329).

framework, Perret could only approach the improvement of metal construction as a threat, not as a complement to reinforced-concrete construction.[58]

One of the main differences between metal and reinforced-concrete construction was the speed of execution. The use of formworks and the time needed for the cement mixture to harden was a major disadvantage of the system. But with the invention of quick-setting cement [*ciment fondu*] during the war, the speed of reinforced-concrete construction could be greatly increased. For Perret, these developments were key to the competitiveness between the two systems. As early as 1922, the Perret Brothers had exploited the qualities of quick-setting cement in alterations made to the headquarters of the Société Marseillaise de Crédit in Paris. In his monthly review on new materials, Abraham described the potential offered by this new type of cement.[59] Because the formwork could now be removed after only three days, reinforced concrete could then rival metal construction in speed of execution. In 1926, Perret confidently stated that "Only a few years ago, reinforced cement could not compete with steel in terms of rapidity: large factories and stores were made of steel. But the invention of quick-setting cement has given to reinforced concrete a new advantage".[60] Though based on a technical assessment, Perret's insistence on the competive equality between the two modern materials had a doctrinal dimension. His ultimate goal was not merely to distinguish between two building materials, but to stress the distinction between two types of architecture.

"L'architecture nouvelle de ciment armé"

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58 See especially: Auguste Perret, "L'architecture à l'Exposition des Arts décoratifs", conference given 17 October 1925 to the former students of the Ecole des Arts et Métiers, Paris, and published in Arts et Métiers, vol. 78, no. 62, 1925, pp. 433-436.

59 Pol Abraham, "Le ciment fondu dans le bâtiment", L'Architecte, vol. 1, January 1924, p. 2.

60 Perret declared: "Voici quelques années, le ciment armé ne pouvait lutter de vitesse avec l'acier: les grandes usines et les grands magasins faisaient donc appel à celui-ci. Mais l'invention des ciments à prise rapide a rendu l'avantage à son rival." La Revue Française (see note 53). See also: Guillaume Janneau, "Les 'Moyens' nouveaux de la Construction", L'Exportateur Français, 27 May 1926, pp. 435-437.

During the first decade of the century, a few architects and critics -- among them Anatole de Baudot and his followers -- had talked about the possible development of an *"architecture du ciment armé"*. After the war, this idea was revived in criticism of the architecture of the Perrets. As has been seen, many reviewers commenting on the Raincy church did not hesitate to present the building as the first sign of a future *"style du béton armé"*.[61] By then, the idea that reinforced concrete could give birth to a specific architectural style was also gaining ground in the larger cultural field. In January 1924, Auguste and Gustave Perret received a proposal to write a book on the architecture of reinforced concrete. The book was to appear in a new collection -- the *Collection d'esthétique scientifique* -- to be published by the Paris publisher Gauthier-Villars. In a letter to the Perrets, the editor wrote: "One of the subjects I would very much like to treat is the architectural possibilities of reinforced concrete. Reinforced concrete is the material of the future and it conditions a new architectural *plastique*, which can be determined by taking into account the properties of the material and adaptating these properties to the new needs of town planning and of well-being."[62] The title of the book, as stipulated in the contract dated 18 January 1924, was to be *"L'architecture nouvelle de ciment armé."*[63]

The book was to be illustrated with a large number of examples of buildings from Europe, North America, and other countries. The visual and textual material was gathered by the architect Charles Imbert, a close friend of Auguste Perret.[64] It was taken from a variety of published sources ranging from commercial periodicals to more theoretical

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61 See for example: G. Boissy, "Les temples modernes", L'intransigeant, vol. 14, 9 July 1923, p. 1.
62 Louis Rougier, letter to Auguste Perret, 7 January 1924 (Fonds Perret, 535 AP 317): "Un des sujets que j'aurais le plus particulièrement à coeur de voir traiter est celui des possibilités architecturales du ciment armé. Le ciment armé est le matériau de l'avenir et il conditionne toute une plastique architecturale nouvelle, que l'on peut déterminer en tenant doublement compte et des propriétés en tant que matériau du ciment armé, et de l'adaptation de ces propriétés aux besoins nouveaux de l'urbanisme et du bien-être."
63 "Collection d'Esthétique Scientifique", author's contract, 18 January 1924 (Fonds Perret, 535 AP 317).
64 "L'esthétique du béton armé", collection of notes by Charles Imbert [c. 1925] (Fonds Perret, 535 AP 317).

publications.[65] As the preserved documents reveal, Imbert was well aware of the most recent works and publications on reinforced-concrete construction. The material was grouped according to building types, building elements, and specific constructional properties. Each sheet was composed of a title, a little sketch, a description, and a precise publication reference. The sketches were made after published photographs of built works. This collection of loose sheets was filled with drawings of industrial buildings, engineering works, and public architecture (fig.59). Yet, excepting the works of a few Dutch architects, it contained no trace of the emerging modernist architecture in France or elsewhere in Europe.

In a note to Perret, Imbert explained that the book was to be organized in nine chapters devoted to a discussion of the aesthetics of reinforced concrete.[66] The "manuscript" was made up of a collection of annotated images rather than a continuous text, emphasizing the aphoristic and poetic quality of the excerpts. The demonstration was not to be based on a chronological reconstruction. The examples were rather selected for their didactic or evocative quality. Imbert planned to contrast the selected works with images taken from various iconographic sources, emphasizing the ahistorical and formal character of the argument.[67] The book was to be published for the 1925 Decorative Arts exhibition held in Paris. As such, it was to be Perret's contribution to the architectural debate that the exhibition was expected to generate.[68] But in a letter dated March 1925, Perret announced that the publication would only be ready for October of that year.[69] In

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65 While many built examples were borrowed from French commercial journals like Le Béton Armé, Le Ciment, and Le Ciment Armé, a large number were taken from E. von Mecenseffy's book Die Künstlerische Gestaltung der Eisenbetonbauten (Berlin, Verlag von Wilhelm Ernst & Sohn: 1911).

66 Charles Imbert, note to [Auguste] Perret, 27 October 1925 (Fonds Perret, 535 AP 317).

67 Imbert planned to compare the Buenos Aires grain elevator taken from Mecenseffy's book with a photograph of an Egyptian colonnade. As such, Imbert would have given iconographic form to the analogies evoked by Walter Gropius and Henri-Marcel Magne.

68 A number of booklets on architecture and the decorative arts were published at the time of the exhibition.

69 Auguste Perret, letter to Louis Rougier, 4 March 1925 (Fonds Perret, 535 AP 317).

the end, the book was neither completed nor published.[70] It's plan provides proof, however, of Perret's commitment to the definition of a *genre* of architecture primarily defined by its material.

Reinforced concrete and the 1925 Art Deco exhibition

The 1925 Art Deco exhibition was a crucial event in the development and the critique of the decorative arts in France.[71] Le Corbusier's vehement critique of the conception of "decorative arts" in L'Art Décoratif d'Aujourd'hui is well known, but beyond that debate, the exhibition was influential in the development of the discussion of modern architecture in France.[72] The critical reception of the exhibition is revealing of the attention paid to new materials in the reading of architectural transformations. It is also a telling indication of the status achieved by reinforced concrete in the discussion of contemporary French architecture.

For Waldemar George, critic of L'Amour de l'Art, the tradition of artistic renewal did not rest with the turn-of-the-century reform of decoration associated with the names of William Morris, Emile Gallée, and Louis Majorelle.[73] Shifting attention to another source, George argued that the real renewal came from the metal structures of the Second Empire conceived by Jacques-Ignace Hittorf, Henri Labrouste, and Gustave Eiffel, and by the work of engineers and scientists.[74] Distressed by the current backwardness of the decorative arts in France, he further claimed: "It is however in France that modern architecture was born: the architecture of metal and glass, the architecture of reinforced

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70 Imbert was later to write one article on the Perrets: "Französiche Architekten ihrer Zeit, A. u. G. Perret", Deutsche Bauzeitung, vol. 60, 13 November 1926, pp. 737-742.

71 For an analysis of this question, see Nancy J. Troy (see note 25), pp. 159 ff.

72 Initiated in a series of articles in L'Esprit Nouveau, Le Corbusier's critique of the decorative arts was pursued in L'Art Décoratif d'Aujourd'hui (Paris, Crès, 1925), published at the time of the exhibition. He proposed to shift attention from the uniquely crafted object of artistic destination to the mass-produced object of purely utilitarian import.

73 Waldemar George, "L'Exposition des Arts Décoratifs et Industriels de 1925. Les tendances générales", L'Amour de l'Art, vol. 6, no. 8, August 1925, p. 283-291.

74 George (see note 73), p. 284.

concrete".[75] In his reading of the exhibition, George did not hesitate to posit modern materials as the primary determinant of modern architecture. In doing so, he also skilfully associated the birth of modern architecture with a specific national context: France.

Other critics also placed the exhibition under the sign of reinforced concrete. For Lionel Landry, the reviewer of Art et Décoration, the forces that triggered changes in forms were the will of the artist, the developing sensitivity of the public, and the implementation of new techniques.[76] Focusing on the decisive role played by the technical element in architecture, the author examined the architecture of the exhibition in light of the various approaches to reinforced-concrete construction. While the various building materials had developed their own language, reinforced concrete was still in need of a common language. For Landry, one goal of the exhibition was precisely to trigger the development of this architectural language.[77] For while the new material had great practical potential, it also had great disadvantages in terms of expression. At the level of expression, Landry identified three possible attitudes. The first was to adopt bare construction, devoid of any decorative elements. The second was to "express" the material by means of technical virtuosity. The third was to adopt the Roman practice and decorate the structure with a revetment that could either express or conceal the structural configuration. Landry's description is indicative of the persistence of conventional criteria of material expression. For while reinforced concrete is presented as a building material in need of an architectural language, the central preoccupation remains the external expression or appearance of the material. The issue of appearance was strikingly emphasized in the author's comment on the source of his analysis. Acknowledging the ephemeral nature of the pavilions, he underlined that his analysis was based not on the

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75 George (see note 73), p. 285: "C'est pourtant en France qu'est née l'architecture moderne: l'architecture de métal et de verre, l'architecture de ciment armé."

76 Lionel Landry, "L'exposition des Arts décoratifs. L'architecture: section française", Art et Décoration, June 1925, pp. 177-213.

77 Landry wrote: "Le béton, au contraire, ne 'parle' pas encore au grand public; un langage commun ne s'est pas encore établi entre créateurs et spectateurs; l'un des objets de l'Exposition doit être précisement d'en accélérer la naissance." Landry (see note 76), p. 178.

materials actually used to build the pavilions but rather on the materials the architect intended to employ if the building were to have been permanent.[78] For Landry, the development of the material's language was ultimately conceived as a problem of imitation, not of execution.

That reinforced concrete could be viewed as the common denominator of the exhibition was confirmed -- if not even consecrated -- by the official report on the 1925 Art Deco exhibition.[79] "1889: apogee of exposed iron; 1900: orgy of *staff* hiding iron structures; 1925: triumph of reinforced concrete, to the point of obsession".[80] With these few words, the author of the report described in a synthetic fashion the progress and setbacks of architecture at French international exhibitions since the turn of the century. The report was published under the direction of Paul Léon, Directeur Général des Beaux-Arts and adjunct commissioner of the exhibition. But it was most certainly written by Henri-Marcel Magne, professor at the Conservatoire National des Arts et Métiers. Acting as director of the exhibition's "Section artistique et technique", Magne was actively engaged in the organization and presentation of the 1925 exhibition.[81] The conception of architecture's developments defended in the report echoed the position adopted in Magne's earlier writings.[82] Eventually published only in 1928, the report is indicative of the themes that were to structure the official discourse on French architecture.

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[78] Landry wrote: "Il est bien entendu qu'au cours de l'étude qui suit les termes "béton armé", "pierre", "ferronnerie" s'appliquent non point à la matière qui a servi effectivement à bâtir les édifices, mais à celle pour laquelle ont été établis les projets." Landry (see note 76), p.182.

[79] Rapport général. Exposition internationale des Arts Décoratifs et Industriels modernes, Paris, 1925, vol. 2, "Architecture", presented by Paul Léon, Paris, Librairie Larousse, 1928. For a brief analysis of the report, see my article: "L'appareil de l'architecture moderne. Notes sur la question du matériau 1900-1925", Les Cahiers de la recherche architecturale, no. 29, 1992, pp. 53-66.

[80] Rapport général (see note 79), p. 23: "1889: apogée du fer apparent; 1900: orgie de staff masquant des charpentes de fer; 1925: triomphe du béton armé, parfois jusqu'à l'obsession."

[81] See Henri-Marcel Magne, Vue d'ensemble sur l'Exposition internationale des Arts décoratifs et Industriels modernes, conference given 18 January 1925 at the Conservatoire National des Arts et Métiers, and published as a pamphlet, Paris, 1925.

[82] In fact, long passages of the volume on architecture were taken directly from previous publications by H.-M. Magne: "L'architecture et les matériaux nouveaux", Art et Décoration, July-August 1919, pp. 85-96; L'architecture, Paris, F. Rieder, 1922.

The review of the exhibition in the official report was introduced under the heading "Modern architecture: New materials - New forms".[83] From the outset, Magne proposed to understand modern architecture as a practice that exploited the conquests of industry, and made use of contemporary materials and construction techniques to realize new architectural programs. As such, the report was largely indebted to Magne's Rationalist interpretation of recent developments in French architecture.[84] Insisting on the relationship between modern materials and modern programs, Magne added: "the *material*, or if one prefers, the *appareil* of modern architecture, is without doubt reinforced concrete."[85] The term *appareil* was an obvious reference to the arrangement of masonry in stone architecture, in an attempt to establish a continuity with the French building tradition. But the etymology of the term also implied the notion of appearance. For Magne, the discussion on reinforced-concrete construction was not related only to the question of structure, but also to the function of external appearance, to the world of the material's "representation".

Like any other material, reinforced concrete commanded its own specific aesthetic.[86] These forms were grand and simple. And if the material could be used for the construction of large vaults, it mostly encouraged a return to the straight line.[87] Taking the works of the Perrets as an example, Magne (quoting Paul Jamot) claimed that a "building solely guided by the rational use of reinforced concrete, with the most economical use of matter and work force, could have its own beauty and, despite the

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[83] Rapport général (see note 79), p. 10: "L'architecture moderne. Matériaux nouveaux.- Formes nouvelles".
[84] For a brief analysis of Magne's own brand of architectural Rationalism, see chapter III.
[85] Rapport général (see note 79), p. 15: "Le *matériau* ou, si l'on préfère, *l'appareil* de l'architecture moderne est, sans contredit, le béton armé".
[86] Magne wrote: "Il y a une esthétique du béton armé, comme de la pierre, du bois, du fer." Rapport général, (see note 79), p. 18.
[87] Magne wrote: "Quelles formes naissent donc le plus naturellement du béton armé ? Des formes simples et grandes (...). S'il se prête aux amples voûtes, il remet surtout en honneur la ligne horizontale. Rapport général (see note 79), p. 19.

absence of any superfluous ornament, could be a work of art."[88] But Magne was no advocate of a single approach. As his earlier writings had made clear, he did not discard the use of decoration. After noting that the walls of reinforced-concrete buildings were made of large naked surfaces, he underlined the potential of revetments: marble panels, inlaid stoneware elements, mosaïcs, stamped relief.[89] Finally, making a veiled reference to Le Corbusier's discourse, he also noted that the aesthetic of reinforced concrete could be developed in works based on bare forms and sharp edges, and on the volumetric harmony of volumes under the play of light and shadow.[90] In his approach to the aesthetic of reinforced concrete, Magne attempted to be inclusive rather than selective. Yet he largely circumbscribed the examples as a contrast between ornamentated and bare forms, framing the issue in decorative terms.

For Magne, the main achievement of the exhibition was not the technical development of the system of reinforced-concrete construction, but rather its diffusion on a large scale. The exhibition trained the eye of the viewer to its impressive spans, its simple volumes, its large cantilevers.[91] The diffusion of the material also extended beyond the traditional building realm. In the introduction to his report, Magne wrote: "1925: triumph of reinforced concrete, to the point of obsession". This obsession was best illustrated by the trees in reinforced concrete erected by the sculptors Jan and Joël Martel to ornament a modern garden designed by Robert Mallet-Stevens (fig.60). For the sculptors, the trees offered a technical demonstration of the decorative, plastic, and

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88 Rapport Général (see note 79), p. 18: "qu'un édifice uniquement régi par l'emploi rationnel du béton armé, avec la plus grande économie possible de matière et de main-d'oeuvre, peut avoir sa beauté propre et, malgré l'absence de tout ornement superflu, être une oeuvre d'art." The quote is from Paul Jamot's A.-G. Perret et l'architecture du béton armé, Paris-Bruxelles, G. Vanoest, 1927, p. 6.

89 A demonstration of the decorative possibilities of the material was given by the pavilion in prefabricated concrete elements designed by Charles-Henri Besnard and Bernard Haubold for the Société de l'Art Appliqué aux Métiers -- of which Magne was a member. See my article: "Paris 1925: an exhibition pavilion", Rassegna, no. 49, March 1992, p. 55.

90 Rapport général (see note 79), p. 19.

91 Rapport général (see note 79), p. 23: "Si l'Exposition n'a pas fait progresser, au point de vue technique, le nouveau mode de construction, elle marquera une date dans l'histoire de sa diffusion. Elle a habitué les yeux à ses portées hardies, à ses volumes simples, à ses larges porte-à-faux."

constructional achievements possible with concrete.[92] Yet by their association with the cubist idiom, the trees highlighted the connection of concrete with the most modern of aesthetic languages.

The current desire to associate concrete with modernity was such that Albert Gleizes, painter and theoretician of cubism, felt compelled to criticize this facile assimilation. Discussing the architecture of the Soviet Pavilion, Gleizes wrote: "Before anything, let me say how pleased I have been to see that the Russian architect had used wood when it would have been so easy to fall into the trap of *reinforced concrete* to look modern." [93] In his report, Magne noted that the reinforced-concrete trees had the value of a symbol.[94] Yet he also warned of the danger of overly extending the use of concrete in an attempt to "appear modern" [*faire moderne*].[95] By 1925, the material was on the verge of being turned into a true fetish of the modern artistic practices.

Perret and the 1925 Art Deco exhibition

Perret did not read the architecture of the exhibition as a triumph of concrete construction. Perret's critique derived from his rejection of the notion of decorative arts and his definition of the architectural ornament. "Decorative art must be suppressed", Perret stated, "but first I would like to know who has connected these two terms: *art* and *decorative*. It is a monstrosity. Where there is true art, there is no need for decoration. What is needed in art is nudity, the beauty of antique or medieval nudity."[96] For Perret,

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92 T., "La nature en ciment armé", Bulletin de la Vie Artistique, vol. 6, no. 15, 1 August 1925, p. 329. See also Miguel Zamacoïs, "Autour d'un Arbre en ciment armé", Le Gaulois, 20 June 1925.

93 Albert Gleizes, "A l'exposition, que pensez-vous du ... Pavillon de Russie", Bulletin de la Vie Artistique, vol. 6, no. 11, 1 June 1925, p. 235: "Avant toute chose, laissez-moi vous dire combien j'ai été agréablement surpris de voir que l'architecte russe avait employé le bois quand il aurait été si facile de tomber dans le panneau du *ciment armé* pour faire moderne."

94 Rapport général (see note 79), p. 23.

95 Henri-Marcel Magne, Les enseignements de l'Exposition internationale des Arts décoratifs et Industriels modernes, (conference given 29 October 1925), Paris, Léon Eyrolles Editeur, 1926.

96 Perret, cited in Marie Dormoy, "Interview d'Auguste Perret sur l'exposition internationale des arts décoratifs", L'Amour de l'Art, vol. 6, no. 5, May 1925, p. 174: "L'Art Décoratif est à supprimer. Je voudrais d'abord savoir qui a accolé ces deux mots: *art* et *décoratif*. C'est une monstruosité. Là où il y a de

the contemporary concern for the straight line and for construction was only a deception, concealing the fact that ornaments were more present than ever. The architect was not against the idea of ornament, only against ornaments not derived from the construction.

In a retrospective reading of the exhibition, Perret further proposed to evaluate the architecture of the pavilions in light of their use of building materials.[97] His review was introduced by a brief presentation on the role played by techniques and materials in the evolution of architecture. His canonic praise and critique of iron architecture served to introduced the final step in this evolution: reinforced concrete, the material that "must give birth to a universal architecture". For Perret, nothing competed with it for the creation of the architecture of the future.[98] This architecture had to be based on a universal principle: the structural skeleton. In Perret's view, it was the correct use of modern materials and construction techniques that led to style, "a necessary step to attaining beauty".[99] He wrote, "On the Esplanade des Invalides, one can see buildings which are, apparently, in reinforced concrete. Nothing in these massive constructions is indicative of this."[100] For Perret, most of the pavilions concealed, by their form and decoration, the material employed.

Perret's call to build according to the nature of the material employed was made more problematic by the ephemeral character of exhibition pavilions. The use of concrete itself could be criticized because the pavilions were to be dismantled. But the main architectural challenge was located at the level of material expression. The theater of the exhibition, designed by Auguste Perret and André Granet, is a case in point. In its construction, the architects combined wooden posts, reinforced-concrete beams, and steel

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l'art véritable, il n'est pas besoin de décoration. Ce qu'il faut en art, c'est la nudité, la belle nudité antique ou médiévale."

97 Auguste Perret, "L'architecture à l'Exposition des Arts Décoratifs", conférence given 17 October 1925, and published in Arts et Métiers, vol. 78, no. 62, November 1925, pp. 433-436.

98 Perret declared: "Je n'aperçois pas ce qui, pour le moment, pourrait concurrencer le Béton Armé pour la création de l'Architecture de demain..." Perret (see note 97), p. 434.

99 Perret (see note 97), p. 435.

100 Perret (see note 97), p. 435: "Sur l'Esplanade des Invalides vous verrez des édifices qui sont, paraît-il, construits en béton armé. Rien dans ces constructions massives de nous le ferait supposer."

trusses, in an attempt to build a temporary yet monumental structure. The wood posts were turned into a series of fluted columns, imitating a reinforced-concrete colonnade. Concerned by the tectonic expression of the theater, Perret ended up simulating the elements of his own architectural language. In view of Perret's call to make the physical and visual properties of materials coincide, the most challenging task was yet to define the "true" nature of the materials themselves.

Marie Dormoy and the definition of French modern architecture in 1925

The 1925 Art Deco exhibition was a key moment in the definition of the cultural status of reinforced concrete; it was also a key moment in the definition of French modernism itself. Modern architects appeared to be united in the critique of the decorative arts.[101] This united front was best illustrated in a 1925 article by Marie Dormoy, in which she offered a synthetic presentation of the state of French modern architecture.[102] From the outset, Dormoy insisted on the primacy of the technical determinant: "What must be admitted is that architecture is first a question of technique, not aesthetic; and that the two important factors to take into consideration are the climate and the material."[103] In light of this statement, the early manifestation of a renewal of French architecture was naturally identified with the works of the Perrets, and their architectural development of reinforced-concrete construction.

In this presentation, Dormoy discussed the works of Auguste Perret and Tony Garnier side by side with the more recent ones of Robert Mallet-Stevens, Le Corbusier and Pierre Jeanneret. With the material established as the common denominator of French modernism, Dormoy chose to minimize the differences among advocates of a renewal of architecture. She insisted on the unity not the divergences of the protagonists. The

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101 Vigato (see note 2), p.35

102 Marie Dormoy, "L'architecture française moderne", La Revue Française de Prague, vol. 4, no. 19, 1 July 1925, pp. 161-170.

103 Dormoy (see note 102), p. 161: "Ce qu'il faut d'abord admettre, c'est que l'architecture, avant d'être une question esthétique, est une question de technique; et que les deux facteurs importants du problème posé sont le climat et le matériau."

coherence of the examples chosen was emphasized by the nature of the material employed: "The stone age is over. We are entering an era of reinforced concrete and cement that will give us a monolithic architecture unknown until now. The few works we have studied here are only the first essays of this new era."[104] Dormoy's article arrived at the juncture of two moments. It was to be the last occurrence of Perret's willing association with the other protagonists of the French avant-garde, and the beginning of the deliberate attempt to frame Perret's work in terms of the *architecture du béton armé*, a doctrinal construct that was to become a strategic tool in the defence of a cultural and ideological program.

2. Perret and the *architecture du béton armé* (1925-27)

In April of 1927, Paul Jamot, art historian and curator at the Louvre, published a book titled A.-G. Perret et l'architecture du béton armé.[105] The book offered the first retrospective presentation of the works of Auguste and Gustave Perret. The flyer announcing the book stressed the direction the modern mouvement was to take: "In architecture, this direction is the rational use of the materials and the means the industry makes available to the builders. If these ideas are becoming more common, it is thanks to Auguste Perret."[106] Jamot was already familiar with the architecture of the Perrets. He had previously written influential reviews on the Champs-Elysées theater and the Raincy church. He had also commissioned Perret for the design of a funerary monument built in Montparnasse cemetery in 1919. From the outset, Jamot developed his thesis upon an unconditional acceptance of the by then conventional Rationalist belief in the role of

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104 Dormoy (see note 102), p. 170: "L'âge de pierre est révolu. Nous entrons dans l'ère du béton armé et du ciment, qui nous doteront d'une architecture monolithe, jusqu'à présent inconnue. Les quelques oeuvres que nous avons étudiées ici ne sont que les premiers essais de cette ère nouvelle."

105 Paul Jamot, A.-G. Perret et l'architecture du béton armé, Paris-Bruxelles, G. Vanoest, 1927.

106 Advertising pamphlet (Fonds Perret, 535 AP 354): "Ce sens, c'est, en architecture, celui d'une utilisation rationnelle des matériaux et des moyens que l'industrie met actuellement à la disposition des constructeurs. Si de telles idées commencent à se répandre, c'est à Auguste Perret plus qu'à tout autre qu'on le doit."

materials. In the introduction to the book, he wrote: "It is natural that a discovery such as reinforced concrete, that is to say a matter that possesses the virtues of plasticity, solidity, and economy, have a profound effect on the conceptions of architects and the style of their works."[107]

Jamot's emphasis on the impact of modern materials echoed the position of most interpreters of Perret's work, among them Marie Dormoy. But the discussion of this issue unfolded within a different framework, revealing a shift in the definition of Perret's architecture. The argument developed in Jamot's book reveals the new positioning of Perret within French architectural culture after 1925, the new role assigned to him in the definition of French modernism.

Jamot and the defence of Perret's architecture

In the book's introduction, Jamot claimed the time was ripe to judge the work accomplished by Perret and to evaluate his role in the renewal of architecture.[108] The timing invoked by Jamot was no doubt related to the recent controversies that had involved Perret with representatives of the architectural establishment. The first of these controversies related to the 1926 competition for the Sainte-Jeanne-d'Arc church in Paris. The second revolved around the discrimination against Perret's students in the design competitions set up by the Ecole des beaux-arts. It is at this moment that Paul Jamot engaged in the defence of Perret and the *architecture du béton armé*. He first published an article defending Perret's project for the Sainte-Jeanne-d'Arc church.[109] It was soon to be followed by a second article in which Jamot made clear that the defence of the church project was to be understood in the broader context of the defence of reinforced concrete

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107 Jamot (see note 105), p. 1: "Il est naturel qu'une découverte comme celle du béton armé, c'est-à-dire d'une matière possédant des vertus éminentes de plasticité, de solidité et de bon marché, retentisse profondément sur les conceptions des architectes et le style de leur ouvrage."
108 Jamot (see note 105), p. 3.
109 P. Jamot, "Les frères Perret et la basilique Sainte Jeanne d'Arc", L'Art Vivant, 1 July 1926, pp. 498-501.

in architecture.[110] Highly polemical in content, these two articles provided the main thesis for the book published in 1927.

In the major competition for the church of Sainte-Jeanne-d'Arc, Perret proposed to erect a 200-meter-high reinforced-concrete structure (fig.61). The church project rested on the possibilities of concrete construction already exploited in the Raincy church of 1923. The plan took the form of a Latin cross. From the base of the church emerged a tower supported by four groups of four vertical round columns. The walls of the church were made of claustras, a system already used at Le Raincy. Perret also exploited the potential of the double-skin wall that first appeared in the project for the Saint-Joseph chapel at Dijon (1925-26). The key feature of the church was the huge campanile, a sort of tower-monument. Perret's church project did not even make the first cut, rejected by the jury on the ground that it ignored the competition conditions, one of which was that the architect was not to be involved in the execution of the building. The Perrets had proposed both to conceive and carry out the execution of the building, proposing to complete the work for a fixed sum.

The project was actively promoted by the proponents of the use of reinforced concrete for the renewal of religious architecture.[111] Maurice Brillant wrote: "Virtuoso of reinforced concrete, it is in concrete that Perret conceived his church. This modern 'material', both supple and strong, enabled him to conceive a monument that is at once beautiful, prodigiously new, and perfectly appropriate."[112] Startled by the jury's decision, Yvanhoé Rambosson engaged in a vigorous campaign to defend Perret's project,[113] and organized an evening presided over by Paul Valéry.[114] Valéry's presence

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110 P. Jamot (see note 1), pp. 642-644.

111 Maurice Brillant, "Une cathédrale moderne", La vie catholique, 26 June 1926; Raymond Régamey, "Pour l'église votive Ste.-Jeanne d'Arc", Journal de l'Est, 14 July 1926.

112 Brillant (see note 111): "Virtuose du béton armé, c'est en béton que Perret a projeté son église. Ce 'matériau' tout moderne, si souple et si fort, dont il joue avec une science et une sûreté incomparables, lui a permis de concevoir un monument d'une beauté, d'une nouveauté prodigieuse et, en même temps, d'une parfaite convenance."

113 Yvanhoé Rambosson, "Au Concours Jeanne d'Arc le beau projet des Perret n'est même pas classé!...", Comoedia, 9 June 1926; "L'archevêché fera-t-il un nouveau concours?", Comoedia, 23 June

was proof of the importance accorded to the defence of Perret's contribution to French architecture.[115] The support given to Perret revealed the growing opposition to the politics of the Ecole des beaux-arts and of the Institut.

The rejection of Perret's project was clearly related to institutional struggles. For many conservative members of institutional bodies, Perret qualified as being more entrepreneur than architect, and lacking an architectural diploma. Perret's status was also debated in connection with the student competitions held at the Ecole des beaux-arts.[116] Since 1923, Perret had been supervising students of the Ecole in the context of an *atelier extérieur*. Yet because he did not have a diploma in architecture, he could not be a member of the Beaux-Arts jury. Despite the quality of their work, Perret's students were most often ignored by the Ecole's jury.[117] This issue of Perret's eligibility coincided with contemporary discussion regarding the creation of an Ordre des Architectes.[118] Perret was against the establishment of a professional organization inspired by the Code Guadet, a set of professional rules of practice grounded on the distinction between the architect and the builder. Interviewed on this issue, Perret declared: "The architect is not only an artist, an inspired form maker, he must also execute the lines he draws, he must build."[119] For Perret, the diploma was no proof of the professional's knowledge of construction.

1926; "Encore le concours de la basilique Jeanne-d'Arc", Comoedia, 29 June 1926; "Un important article de Paul Jamot", Comoedia, 17 July 1926.

[114] On 11 June 1926, Yvanhoé Rambosson gave a conference entitled "Hommage aux Architectes A. G. et C. Perret". Presided over by Paul Valéry, the event provided Rambosson with an ideal occasion to attack the decision of the jury and the members of the Institut. A member of the Institut himself, Valéry did not take part in the debate in order not to be in conflict with his own collegues. (Fonds Perret, 535 AP 330)

[115] On the relation between Valéry and Perret, see Bruno Foucart, "Paul Valéry devant l'architecture de son temps, d'Eupalinos à Auguste Perret", in Paul Valéry et les Arts, Paris, Actes Sud, 1995, pp. 37-50.

[116] Articles were published in Le Quotidien, La Liberté, Le Figaro, Comoedia, Petit Journal, L'Intransigeant.

[117] G. Chennevière, "La routine et l'esprit réactionnaire à l'Ecole des Beaux-Arts", Le Quotidien, 20 July 1926; R.G., "Faut-il réformer la composition du jury d'architecture des Beaux-Arts", Le Figaro, 16 June 1926.

[118] A series of articles was published in Comoedia, Humanité, Les Débats, L'Architecte.

[119] Jean-Pierre Liausu, "Doit-on réglementer les cabinets d'architectes ?", Comoedia, 30 June 1926: "L'architecte n'est pas seulement un artiste, un rêveur de formes, il faut que les lignes des ses projets soient exécutées par lui, qu'il bâtisse, qu'il construise."

The rejection of Perret's church project and the discrimination suffered by Perret's students was intricately related to the current debates on the institutional status of the architect. Yet according to Perret, this ostracism was also motivated by deeply rooted architectural bias. Taking the Sainte-Jeanne-d'Arc church project as an example, Perret rhetorically asked why the project had been rejected. "Because", he argued, "the only material that interests me is concrete. It is the most economical and the most durable. We build warehouses and platforms in concrete. But it is forbidden to build public monuments in concrete!"[120] Perret believed his students in the *atelier extérieur* were overtly discriminated against because of their use of reinforced concrete.

Many of the critics who protested the decision of the Sainte-Jeanne-d'Arc competition's jury agreed with and reiterated Perret's argument. In their opinion, the discrimination against Perret was undoubtedly based on a rejection of his preferred material. "We are told that in the higher academic and official realms, this *material* is considered undesirable ", wrote the reviewer of Le Bâtiment, adding: "The reason the Perrets project was rejected was because of the use of a material that is not considered a *noble material*."[121] The same critique also came from members of Beaux-Arts jury. In an open letter to the Conseil supérieur of the Ecole des beaux-arts, A. Guilbert -- architecte en chef des bâtiments civils et des palais nationaux -- complained of the overt hostility shown to Perret's students.[122] One cause of that discrimination was obvious: the material advocated. In a subsequent article, Guilbert declared that "many well-intentioned people would be surprised if they were to learn that in the architectural student competitions held at the Ecole des beaux-arts some materials are in a state of disgrace and official juries

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120 Chennevière (see note 117): "Parce que le seul matériau qui m'intéresse est le béton. C'est le plus économique et le plus durable. On construit des hangars et des plate-formes en béton. Mais il est interdit de construire en béton des monuments publics !"

121 G. I., "L'Architecture moderne et les Jurys officiels", Le Bâtiment, 16 September 1926: "On nous signale que ce *matériau* est considéré, dans les sphères officielles et académiques, comme indésirable." -- "La raison du refus du projet présenté par MM. Perret serait donc l'emploi d'une matière qui n'est pas classée dans les *matières nobles*."

122 "Tolérera-t-on la proscription des artistes novateurs?", Comoedia, 17 June 1926.

condemn their use, or at the very least, penalize it."[123] Guilbert was ready to concede that bare concrete was not particularly sympathetic as a material, and had to be covered with more noble materials where visitors brushed against it. But he also added that, "it cannot be denied that in the case of bold gestures [in concrete], whether with long spans or soaring verticals, the resulting effects can be daringly expressive of the material."[124] Taking the work of the Perrets as an example, Guilbert argued that the use of concrete could be highly respectful of the Greek and thus of the classical spirit. "This is why I vehemently condemn the discredit heaped upon new materials and the sole modern technique that has an indisputable classical quality."[125]

On the status of the material

In his July 1926 article, Jamot argued that after the domination of stone, brick, and iron, it was time for the reign of reinforced concrete: "Concrete must govern, it must show itself without hypocrisy, its power and virtues should be felt everywhere."[126] For Perret and his circle of supporters, the status of concrete had to be elevated, raised to the level of a noble material. Until 1925, Perret had insisted upon presenting reinforced concrete as the most modern material, the rival of steel. Yet by the mid-1920s, the material was increasingly associated with the notion of "modern stone", adding a traditionalist facet to its modernist reputation. In a 1925 article on modern architecture, Perret did not hesitate to describe reinforced concrete as "rejuvenated stone".[127] In a 1925 interview by Marcel

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123 A. Guilbert, "L'Architecture moderne et l'Ecole des Beaux-Arts", Le Journal, 19 August 1926: "On étonnerait bien des gens de bonne foi en leur apprenant que, dans les concours ouverts à l'Ecole des beaux-arts entre les élèves architectes, il est des matériaux en disgrâce et dont les jurys officiels condamnent l'emploi ou dont, tout au moins, ils pénalisent l'usage."

124 A. Guilbert (see note 123): "mais il n'est pas niable que pour certaines expressions audacieuses, qu'il s'agisse de grandes portées ou d'envolées verticales, les effets qu'on peut en tirer exaltent singulièrement la matière."

125 A. Guilbert (see note 123): "Voilà pourquoi je réprouve hautement le discrédit dont on frappe l'emploi des matières nouvelles et la seule technique moderne qui soit précisément d'une qualité classique indiscutable."

126 Jamot (see note 109), p. 501: "Il faut que le béton gouverne, il faut qu'il se montre sans hypocrisie, il faut qu'il fasse partout sentir son pouvoir et ses vertus propres."

127 Georges-Louis Garnier, "Auguste Perret et l'architecture moderne", La République des Arts, 1925: "C'est de la pierre rajeunie !" (Fonds Perret, 535 AP 330).

Mayer, Perret further equated reinforced concrete with stone construction.[128] For Perret there was a direct connection between stone and concrete: "If cut stone is less and less accessible, nothing prevents us from producing a concrete made out of Burgundian stone.... Worked with the hammer, one would swear that it was real stone."[129]

Though the comparison of concrete with stone had not been absent from architectural discourse during the first two decades of the century, Perret's statements of the mid-twenties were framed within a very different cultural context. Since the war and reconstruction, the material was now associated with the modernization of construction, and during the 1925 Art Deco exhibition acquired another layer of meaning as reinforced concrete was being turned into a virtual fetish of modern building. Commenting on the concrete trees built by the Martel brothers, Perret declared that they were more than a mere novelty, but only because they provided a genuine idea of the possibilities offered by the material.[130] Thus Perret drew his retrospective analogy between concrete and stone at the very moment the material was being turned into a modernist fixation. Rebutting the modernist connotations of concrete, Perret insisted on the association of the "most modern material" with the oldest material of the French tradition. By the mid-1920s, Perret came to view concrete as a "young" material that would replace an "old" one.[131] This process of substitution had implications that were at once architectural and cultural.

Now shifting his attention away from the technique of the building system, Perret was more and more concerned by the external appearance of the concrete, conceived as a

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128 Marcel Mayer, "Eglises en béton armé", La Revue de Bourgogne, vol. 15, no. 7, 15 July 1925, pp. 357-366.

129 Mayer (see note 128), p. 365: "Si la pierre taillée nous est de plus en plus inaccessible rien ne nous empêche de faire du *béton de pierre de Bourgogne*.... Repris à la boucharde, on jurerait la pierre elle-même."

130 Auguste Perret, cited in "A l'exposition, que pensez-vous des... arbres en ciment armé des frères Martel", Bulletin de la Vie Artistique, vol. 6, no. 16, 15 August 1925, p. 352.

131 According to Abel Fabre, Perret insisted on the distinction between old and young materials. Quoting Perret, Fabre wrote: "La pierre est un matériau vieux: quand on l'extrait de la carrière, elle achève de mourir. Le béton de ciment armé est un matériau jeune, qui a toute la vie devant lui." Fulcran, "La taille directe et la mort du praticien", La Croix, 1927 (Fonds Perret, 535 AP 330).

product that could itself become a noble material. Perret's attention to the appearance of concrete in a public building was first manifest in practice in the Raincy church project. Yet at Le Raincy the architect's choice was globally motivated by economic constraints.[132] Taking this problem into consideration, Perret had exploited ornamental features, such as the fluting of the columns, to hide the traces left by the construction process. But already a year later, with the Grenoble tower project designed in 1924, Perret was actively engaged in the execution of a public building conceived from the outset as a monument made entirely of exposed concrete.

The desire to view concrete as a positive substitute for stone was most clearly expressed in the context of the Sainte-Jeanne-d'Arc project. In his defence of the project, Jamot wrote: "Our architect prefers to leave the concrete naked, even when it is visible, because a concrete which is well worked, polished, 'bush-hammered', takes on an appearance comparable to that of granite -- that is to say, to the most beautiful, hardest, most durable of matter previously considered as precious, and it will last longer than granite."[133] For Jamot, it was crucial to demonstrate that concrete could be perceived as a noble material. As such, reinforced concrete could be exposed mainly because it looked like something else, indeed, looked like granite, a noble material -- not because it had a modern appearance of its own. The elevation of the status of concrete depended on its affinity with stone, the noblest material of the French building tradition, not on the development of a new aesthetic paradigm. Looking backward rather than forward, Perret and his supporters made no attempt to question the notion of "noble material" itself.

This elevation of the status of concrete depended, in fact, on the transformation of the external appearance of the material's surface, which had important implications both

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[132] On the role of the Raincy church as a precursor of the New Brutalism in architecture, see Peter Collins, "The new brutalism of the 1920s: the effect of economic restraints at Notre Dame du Raincy", JSAH, vol. 33, no. 3, 1974, p. 233.

[133] Jamot (see note 109), p. 501: "Mais notre architecte aime infiniment mieux laisser le béton apparent, même à portée du regard, car le béton bien travaillé, poli, 'bouchardé', comme on dit, peut prendre un aspect comparable à celui du granit, c'est-à-dire à la plus belle, à la plus dure, à la plus durable des matières autrefois considérées comme précieuses, et il durera plus longtemps que le granit."

for the mode of production and for the work force. The production of a concrete that could resemble stone required a special selection and mixture of components, carefully crafted formworks, careful pouring techniques, and a skilled treatment of the resulting surfaces. The production of such a high-quality concrete required sophisticated craftsmanship -- a conception of concrete construction that was more and more at odds with the architectural avant-garde's calls for the industrialization of construction.

Perret and the Romano-gothic tradition

Perret's assimilation of concrete to "modern stone" conjured up the memory of the French Gothic tradition. For some members of his circle, this connection with Gothic architecture was made without reservation. Writing about the Sainte-Jeanne-d'Arc church project, Jamot made the connection explicit: "Thanks to reinforced concrete and to the changes it brings about, Auguste Perret -- bridging five or six centuries -- achieves the ideal of the Middle Ages."[134]

Until 1925, most interpreters of Perret's work had insisted on its affiliation with nineteenth-century architecture. The work of Marie Dormoy is a case in point. For Dormoy, the rebirth of French architecture, after many years of decadence, took place in the nineteenth century, partly due to the rise of iron architecture embodied in the works of Labrouste, Baltard, Duban, and Dutert. In the early twentieth century, metal was replaced by reinforced concrete, a material that achieved its architectural character in the works of the Perrets. Developed during the 1910s, this interpretation was still advanced by Dormoy in articles written at the time of the 1925 Art Deco exhibition.[135]

Yet around 1925 the interpreters of Perret's work were to place greater emphasis on the notion of the great French tradition. Bypassing the nineteenth-century, highlighted by the achievements of iron architecture, these writers insisted on the Gothic and Classical

[134] Jamot (see note 109), p. 501: "Grâce au béton armé et avec les modifications qu'il implique, Auguste Perret nous offre, par dessus cinq ou six siècles, l'épanouissement de l'idéal du Moyen Age."
[135] Dormoy (see note 102); see also M. Dormoy, "Une exposition d'Art Français à Vienne", L'Art Vivant, no. 9, 1 May 1925.

affiliation. In his July 1926 article devoted to the Sainte-Jeanne-d'Arc project, Jamot presented Perret's work in terms of the achievement of the Gothic ideal.[136] In his September 1926 article devoted to Perret's architecture in general, Jamot declared that concrete was more suited than any other material to achieve a conception of art that was "highly classical, and thus, highly French."[137]

Marcel Mayer played a major role in the construction of this interpretation.[138] Ignoring the connection with the nineteenth century, Mayer emphasized the connection with the French Romanesque and Gothic tradition of the twelfth century. In an article of 1925, Mayer developed an analogy between the Gothic intersecting ribs and the use of reinforced concrete: "just as the pointed arch had been the source of a new style, the Perret brothers see in the use of reinforced concrete not only the possibility but the necessity of a distinctive architecture."[139] He insisted on the analogy between stone and concrete, emphasizing the (mono)lithic quality of the material. Mayer's viewpoint was more developed in a following article that extended the discussion to the broader field of reinforced-concrete architecture.[140] For Mayer, the source of the Perret brothers' approach was to be found in their family's native soil. Coming from the Cluny region, the Perrets had the temperament of the Cluny builders, known for their love of "materials and forms". "With the Perret's", Mayer wrote, "one finds the strong logic, the simple rhythms, the sober and elegant orders of the twelfth century builders."[141] He added that the Perrets were disciples of the master builders of Autun, Paray-le-Monial, and Notre-

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136 Jamot (see note 109).

137 Jamot (see note 1), p. 644: "la plus classique et la plus française."

138 Marcel Mayer remains an enigmatic figure. I have not been able to find any substantial information on his training and professional position. A forthcoming work by Jean-Claude Vigato will hopefully bring more information to light.

139 Mayer (see note 128), p. 360: "Or, de même que la croisée d'ogive avait été le germe du nouveau style, de même les frères Perret voient dans l'emploi du béton armé non seulement la possibilité, mais la nécessité d'une architecture propre".

140 Marcel Mayer, "De Cluny au béton armé. Les oeuvres nouvelles de A. et G. Perret", La Revue de Bourgogne, vol. 16, no. 4, 15 April 1926, pp. 230-238.

141 Mayer (see note 140), p. 233: "On retrouve chez eux la forte logique, le rythme simple, ample et nombreux, l'ordonnance sobre et élégante des bâtisseurs du XIIe siècle".

Dame de Beaune, presenting the Bourgogne region as the cradle of the French Romanesque tradition.[142]

Mayer's insistence on the impact of family roots in the development of Perret's architecture was taken up by Jamot. For Jamot, this connection with the Bourgogne region was envisioned as the source of a key development in twentieth-century architecture: the absence of ornament. Jamot wrote: "Isn't it curious that the artist whose destiny it was to guide architecture toward a bare and unornamented style came from this region where the Cluny Order magnificently enhanced the development of Romanesque architecture eight centuries ago."[143] Making a direct reference to the Cluny abbey, Jamot underlined the fact that the beauty of the church derived solely from the purity and the boldness of its lines and the correctness of its proportions.[144] For Jamot, the source of Perret's undecorated architecture was to be found in twelfth-century architecture, not in the early-twentieth-century critique of ornament.[145]

With his praise of the twelfth and thirteenth centuries -- a period that preceded the decadence of the fourteenth century -- Mayer might appear merely as a late Rationalist trained in the school of Viollet-le-Duc. Yet for Mayer, the Perrets' deep relation with the building tradition of the Bourgogne was not the sole source of their artistic vision: "If Auguste and Gustave Perret are, without doubt, profoundly French because of their taste, I am pleased to find in their solid elegance the breath of Cluny and the Greek sensibility."[146] This evocation of both the Gothic and Greek precedents had already been noted in a 1925 interview given by Perret. Commenting on Perret's approach, the

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142 An interpretation synthesized in Auguste Choisy's Histoire de l'architecture published in 1899.

143 Jamot (see note 105), p. 3: "N'est-il pas curieux que l'artiste, dont la destinée était d'orienter l'architecture vers un style nu et sans ornement, vienne de cette région où l'Ordre de Cluny donna, il y a huit siècles, un magnifique essor à l'architecture romane."

144 Jamot (see note 105), p. 3.

145 In his manuscript notes of 1914 entitled "Le style sans ornement", Perret made reference to Adolf Loos's ideas on the ornament. But Jamot's interpretation is oblivious to all the early-twentieth-century sources on the critique of ornamentation in architecture, and notably of Loos' contribution.

146 Mayer (see note 140), p. 238: "Si A. et G. Perret sont, sans conteste, d'essence profondément française par le goût, il me plaît de retrouver dans leur solide élégance le souffle clunisien et le sentiment grec."

anonymous reviewer wrote: "Auguste Perret, master of the modern school, is not only a fervent and learned disciple of the French *grand siècle* -- the one that created Gothic architecture -- but also of Greece, intellectual and rationalist."[147] In the description of the Greek temple published in his Entretiens sur l'architecture, Viollet-le-Duc had already insisted on the logic and sensibility of the Greek people.[148] But Mayer's conception of the Greek ideal was undoubtedly related to the renewed interpretation of Classicism that was largely diffused in the 1920s through the works of Paul Valéry, André Gide, and others.[149] To stress the historical importance of building materials and practices, Mayer naturally focused on the medieval, not the classical tradition. Yet before long, Mayer was to fully reintegrate his rationalist rhetoric within the framework of the Classical ideal, celebrating the classicism of Perret's architecture.[150]

In 1926, Marcel Mayer completed a biography of Auguste Perret.[151] The details contained in the manuscript are proof of the close connection between the writer and the architect. Though the manuscript was never published, the monograph can be securely taken as an "authorized" presentation of Perret's position.[152] Mayer insisted on the unique synthesis presented by Perret's architectural practice. He did so at a time, in the mid-1920s, when French architectural bodies were engaged in a discussion of the professional status of the architect. Opposing the contemporary attempt to establish architecture as a profession, Mayer argued that in the realm of modern construction the practices of architecture and engineering had to be linked. As such, he was apparently in

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147 La Revue Francaise (see note 53): "Auguste Perret, maître de l'école moderne, n'est pas seulement le disciple fervent et savant du grand siècle français -- celui qui créa l'architecture ogivale -- mais aussi de la Grèce, intellectuelle et rationaliste." The reviewer identifies the *grand siècle* with the birth of Gothic architecture, not with the seventeenth century that witnessed the consecration of French classicism.

148 E. Viollet-le-Duc, Entretiens sur l'architecture, vol. 1, Paris, 1863, p. 51.

149 On this question, see Gargiani (see note 4), pp. 92-93.

150 See Marcel Mayer, "L'architecture du béton armé. Une Oeuvre Classique", L'Amour de l'Art, vol. 9, no. 7, July 1928, pp. 266-269.

151 Marcel Mayer, "Auguste Perret. L'homme, l'oeuvre, le novateur", unpublished manuscript [c. 1926], 275 pp. (Fonds Perret, 535 AP 358).

152 Mayer later wrote an essay on Perret published in an illustrated monograph on the architect's work: A. & G. Perret (Les Albums d'Art Druet XVI) Paris, Librairie de France F. Sant'Andrea, 1928.

agreement with the position of more radical architects like Le Corbusier. But this synergy between the architect and the engineer was not deemed sufficient, for both remained dependent on the entrepreneur. "With Perret", Mayer wrote, "the trilogy is complete: plans, execution are from the same hand, following the medieval tradition; evolving under the daily control of experience, the master builder, judge of all the possibilities but also of all necessities, can work with freedom and safety. Thus understood, the name 'builder' regains all its grandeur."[153] Echoing Mayer's position, Jamot also praised the fact that Perret was both architect and entrepreneur, giving credit to the analogy with the medieval *maître-d'oeuvre* that combined the artist and the builder.[154]

Mayer clearly distinguished between Perret and Le Corbusier, opposing the French qualities of the former to the austerity and rigor of the latter.[155] Thanks to his analogy with the medieval *maitre-d'oeuvre*, Mayer was able to insist on the Frenchness of Perret's architectural practice. According to Mayer's interpretation of the French building tradition, the architect was a builder but also an artist. And if the mastery of reinforced concrete depended on the quality of the engineer, it could only be fulfilled with the spirit of the artist, the French artist.[156]

Perret and the paradigms of concrete construction

These interpretations of Perret's work from the mid-1920s involved an assessment of the dominant formal characteristics of reinforced-concrete architecture. Jamot insisted on the verticality of this architecture, stressing the governing role of concrete in the Sainte-

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153 Mayer (see note 151), pp. 35-36: "Chez Perret, la trilogie est complète: plans, exécution sont de la même main, selon la tradition médiévale; évoluant sous le quotidien controle de l'expérience, le 'maître d'oeuvre', juge de toutes les possibilités mais aussi de toutes les nécessitees, peut travailler avec liberté et sureté. Ainsi compris le mot 'constructeur' recouvre toute sa grandeur."

154 Jamot (see note 105), p. 4: "Au lieu de devenir, comme tant d'autres, un homme qui fait, ou fait faire, dans un bureau, des plans et des dessins, sans daigner savoir comment ni par qui ni par quels moyens ils seront réalisés sur le terrain, il ne sépara jamais dans son esprit la tâche de l'artiste et celle du constructeur. Par là, il se trouvait acheminé vers une conception heureuse qui a fait ses preuves au moyen âge."

155 Mayer (see note 140), p. 232.

156 Mayer (see note 140), p. 238

Jeanne-d'Arc project: "Obviously, it [concrete] is more adapted to the vertical than to any other line. But Gothic architecture, which adopted this configuration for other reasons, offers telling proof that verticality can create beauty, richness, and variety."[157] The derivation of this formal characteristic was obviously phrased in the context of the discussion of Perret's religious architecture. Yet it had a powerful impact on the broader interpretation of the nature of concrete architecture.

Jamot was not alone in presenting verticality as a dominant feature of concrete construction. In a 1927 publication offering an overview of contemporary architecture in concrete, the British architect Thomas P. Bennett shared this interpretation: "Incidentally a number of extremely valuable facts are open for investigation, and above all is the dominating idea of verticality as distinct from the old horizontality of the classic tradition."[158] Bennett noted the formal similarity between the verticality of modern concrete architecture and the Gothic tradition. But he also stressed a distinction from Gothic architecture, expressed in constructional terms, emphasizing the "continuity of the vertical support" achieved in modern buildings.[159]

Jamot's and Bennett's emphasis on verticality contrasted with the contemporary modernist's belief that horizontality was a key characteristic of reinforced-concrete architecture. In France, both Le Corbusier and Robert Mallet-Stevens viewed horizontality as one of the main achievements made possible by concrete construction. Invited by the editor of Wendingen to comment on the architecture of Frank Lloyd Wright, Le Corbusier wrote in a 1925 letter to H.T. Wijdeveld: "Wright introduced order, and he imposed himself as an architect. Moreover, his sections and facades took into account reinforced concrete. At that time, it was a real accomplishment. To my knowledge, Wright was one of the first to indicate the architectural solutions for

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[157] Jamot (see note 109), p. 501: "Evidemment, il est plus favorable à la verticale qu'à tout autre ligne. Mais l'architecture gothique, que d'autres motifs ont conduite à la même prédilection, est là pour nous apprendre ce que la verticalité peut donner de beauté, de richesse et de variété."
[158] Thomas P. Bennett, Architectural Design in Concrete, New York, Oxford Univ. Press, 1927, p. 7.
[159] Bennett (see note 158), p. 8.

reinforced concrete. Others employed reinforced concrete without discovering its essential rhythm, but he affirmed the horizontal, that marvelous contribution of reinforced concrete, and an architectural value of the highest order."[160]

Mallet-Stevens was also approached by Wijdeveld. In the article he published in Wendingen, Mallet-Stevens also alluded to the connection between reinforced concrete and "horizontal architecture".[161] In his 1926 conference given at the Université des Annales, Mallet-Stevens further developed his argument on the idea of horizontality, which was the key feature of reinforced-concrete construction, appearing on buildings conceived simultaneously on different continents.[162] This argument was substantiated with the instance of a villa by Frank Lloyd Wright: "What is striking is this will for horizontal lines, lines that can be realized only with reinforced concrete."[163] It was further supported with projects by the Dutch Cornelius van Eesteren and Ferdinand Kramer, the German Erich Mendelsohn, the French Gabriel Guévrékian and Henri Sauvage and the Austrian Haertel. Mallet-Stevens insisted that many of these projects were directly indebted to reinforced-concrete construction.[164]

Despite major differences in the building types discussed, this comment reveals a radical discrepancy in the understanding of the role of reinforced concrete as the modern structural material. For the French advocates of Perret and concrete architecture, as for their British counterpart, reinforced concrete was naturally suited to vertical forms. For

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[160] Le Corbusier, letter to H. T. Wijdeveld, 5 August 1925: "Wright ordonnait et s'imposait en architecte. Mais de plus, ses coupes et ses facades faisaient état du ciment armé. A ce moment là, c'était un titre. Or Wright, l'un des premiers à ma connaissance, désignait les solutions architecturales du béton armé. D'autres employaient le béton armé sans découvrir son rythme essentiel, lui affirmait l'horizontale, apport merveilleux du ciment armé et valeur architecturale de premier ordre." Quoted in Paul V. Turner, "Frank Lloyd Wright and the Young Le Corbusier", JSAH, vol. 42, no. 4, December 1983, p. 359.

[161] Robert Mallet-Stevens, "Frank Lloyd Wright et l'architecture nouvelle", Wendingen, no. 9, 1925. The article was republished in H.T. Wijdeveld, The Life-Work of the American Architect Frank Lloyd Wright, Santpoort, C. A. Mees, 1925 (reprint: Horizon Press, 1965), pp. 92-93.

[162] Robert Mallet-Stevens, "Les raisons de l'architecture moderne dans tous les pays", Conferencia - Journal de l'Université des Annales, vol. 20, no. 24, 1 December 1926, pp. 585-597.

[163] Mallet-Stevens (see note 162), p. 590: "Ce qui frappe tout de suite, c'est cette volonté de lignes horizontales, lignes que seul le béton armé permet de réaliser."

[164] On Guévrékian's hotel project, Mallet-Stevens wrote: "La façade entière est d'une belle simplicité et, sans le secours du béton armé, un tel édifice serait inconcevable." Mallet-Stevens (see note 162), p. 592.

the French protagonists of the new architecture, reinforced concrete permitted the horizontality that was characteristic of modern architecture.

In his attempt to define the characteristics of Perret's architecture, Jamot engineered a comparison with other exemplary works of reinforced-concrete construction. Contrasting Perret's architectural work with the Einstein tower by Erich Mendelsohn, Jamot wrote: "At the Potsdam Institute of Astrophysics, Erich Mendelsohn models concrete in compact masses the way a sculptor would knead clay. Their taste for the colossal and the cyclopean makes them forget that concrete, at once the most ductile as well as the hardest and most resistant of materials, must suggest to the architect an ideal of lightness."[165] Central to this definition was the affirmation that lightness had to prevail over mass, that structure had to prevail over plasticity. Taking Mendelsohn's work as an example, Jamot argued that the search for the expression of mass and plasticity contradicted the fundamental nature of the material. Interestingly, Jamot assumed that the Einstein Tower was constructed of concrete, though the architect -- confronted with the problem of the formwork -- had finally opted for a brick construction covered with a cement coating.

That reinforced concrete could be associated with mass construction had been noted and criticized by other advocates of Perret's architecture. In a critical review of André Ventre's project for the Monument de la Pointe de Grave, Jean Badovici noted the temptation to use concrete to express mass construction (fig.62).[166] Commenting on the external appearance of the project, Badovici wrote: "The honest treatment of the material required that the artist give to the edifice an appearance in agreement with the principles of reinforced concrete. In its appearance, the edifice leads us to believe that it is built of a

[165] Jamot (see note 105), p. 79: "A l'Institut d'astrophysique de Postdam, M. Eric Mendelssohn [sic] le modèle en masses compactes, à la façon d'un sculpteur qui pétrit la glaise. Aux uns et aux autres leur goût du colossal et du cyclopéen a fait méconnaître que le béton, étant à la fois la plus ductile, la plus dure et la plus résistante des matières, doit suggérer à l'architecte une loi, un idéal de légèreté."
[166] J. Badovici, "Entretiens sur l'Architecture vivante", L'Architecture Vivante, vol. 1, Fall 1923, pp. 16-19.

mass concrete, though the thickness of the walls never exceeds 15 centimeters."[167] While concrete was often criticized for its weightiness, Perret believed that the goal was to conceive forms that achieved a certain degree of lightness. Paraphrasing Perret's words, Louis Charvet wrote in a 1927 article: "There was a great temptation to seek, in massive forms, the expression of strength that the material contained in itself, to imitate the piling up of stones in large constructions".[168] Instead, Perret praised the correctly proportioned column, the "fundamental element, the most beautiful, the one that rises and supports."[169] This fundamental principle of Perret's doctrine of concrete architecture was beginning to be well understood by foreign observers. Commenting on the Grenoble Tower, Howard Robertson wrote: "The predominant structural effect is of strength and lightness, and there is no suggestion whatever of that masonry-like quality which in the opinion of Monsieur Auguste Perret is one of the main weaknesses in modern design in reinforced concrete. Structures such as the Einstein Tower of Erich Mendelsohn would come under this heading of criticism, the argument being that the nature of the material permits of the lightest type of framework and infilling, and that the use of heavy masses of concrete (except for special purposes) is unnecessary and uneconomical."[170]

By 1927, Perret's work had become an important reference point in the contemporary search for the defining features of reinforced-concrete architecture. This search was complicated by the competing understanding of the building technique's basic principles. Bennett's conception of monolithism is a case in point. For Bennett, verticality was only one possible expression of concrete architecture. Taking

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167 Badovici (see note 166), p. 17: "La sincérité de la matière exigeait par conséquent de l'artiste qu'il donnât à son édifice un aspect conforme au principe même du ciment armé. Tel quel, cet édifice nous laisse croire qu'il a été construit en béton hydraulique massif bien que l'épaisseur des murs ne dépasse jamais 15 centimètres."

168 Louis Charvet, "Visites d'ateliers: les constructeurs Auguste Perret", Revue des Jeunes, 10 January 1927, pp. 58-59: "La tentation était grande de chercher dans le massif l'expression de puissance que cette matière confusément portait en elle, de mimer les entassements nécessaires avec la pierre pour les grandes constructions".

169 Charvet (see note 168), p. 59: "l'élément fondamental, le plus beau, celui qui monte et qui soutient".

170 Howard Robertson, "Buildings by the Brothers Perret. A Notable Contribution towards the Architecture of Concrete", The Architect & Building News, 4 March 1927, pp. 400-402.

Mendelsohn's Einstein tower as an example (fig.63), he wrote: "The next quality of concrete which must receive attention is its monolithic character. ... A monolith is impressive if its size and unity can be appreciated, and if the ability to express these qualities can be acquired a new group of compositions should be realized. If Monolithic unity is considered alone, the most successful design illustrated here is undoubtedly that of the Einstein Tower by Eric Mendelsohn. In this design the rounded corners, the splays, the broadly recessed reveals, the battered faces and absence of mouldings make the tower and the rooms at its base look as if it were created by the sweep of a giant hand."[171] For Bennett, the treatment of reinforced concrete in terms of mass construction evoked the idea of monolithism. Perret and his interpreters also insisted on the monolithic quality of concrete constructions. But monolithism was located in the logic of the frame, not the appearance of the form.

1905 and the birth of reinforced-concrete architecture

Opposing Perret's search for lightness with the weightiness of other concrete buildings, Jamot sought to identify the key moment in the definition of a true *architecture du béton armé*. For Jamot, the key work of Perret's early career, a work that was to guide all later developments, was the rue de Ponthieu garage. In an article written at the height of the debate on the Sainte-Jeanne-d'Arc church, he wrote: "The construction of the rue de Ponthieu garage (1905) is the key date of a history that will honor our country before posterity."[172] In his 1927 monograph he was more explicit about the garage's achievement: "As early as 1905, the rue de Ponthieu Garage demonstrated that, without false ornamentation, the logic of the skeleton, the soundness of proportions, and the care of execution are the necessary and sufficient elements by which an engineer-artist can

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171 Bennett (see note 158), p. 11.

172 Jamot (see note 1), p. 642: "La construction du garage de la rue de Ponthieu (1905) est la date capitale d'une histoire qui fera honneur à notre pays devant la postérité."

generate beauty, the original beauty of an architecture that will be the *architecture du béton armé*."[173]

Commissioned in the spring of 1906, the garage was completed only in 1907. Jamot's misdating of the garage to 1905 only helped turn Perret into the precocious inventor of reinforced-concrete architecture. In fact, Jamot's assessment of the 25bis rue Franklin apartment building built in 1903 was negative. In demonstrating that the fundamental character of architecture derived from the structural skeleton, the rue Franklin building was a step in the right direction, but Jamot was uncomfortable with the external revetment of the building, indebted as it was to the aesthetic of 1900. For Jamot, the real demonstration was to unfold with the rue de Ponthieu garage, where the rhythm created by the concrete skeleton gave the facade its harmony (fig.64). He noted that "the skeleton of the construction only appears on the facade", and that the vertical posts were slightly curved, implying that the garage's aesthetic was a question of expression and proportions, not simply of material display.[174]

Jamot's insistence on the inaugural character of the garage gave a new twist to the interpretation of Perret's work. In her articles of 1923 and 1925, Marie Dormoy had focused on the Champs-Elysées theater as the key building in the development of Perret's reinforced-concrete aesthetic. While the garage was the first example of the new architecture in terms of conception and realization, Dormoy argued, the new material only received its real aesthetic consecration with the theater.[175] By contrast, Jamot argued that the garage's facade had anticipated the facade of the Champs-Elysées theater.[176] Citing this precedent allowed Jamot to dismiss the important design contribution of Van de Velde and Bourdelle. Yet more importantly, by locating the birth of the *architecture du*

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[173] Jamot (see note 105), p. 80: "Dès 1905, le Garage de la rue de Ponthieu montrait que, sans ornements factices, la logique de l'ossature, la justesse des proportions et le soin donné à l'exécution sont les éléments nécessaires et suffisants d'où un génie d'ingénieur et d'artiste peut faire surgir de la beauté, la beauté originale d'une architecture qui sera l'architecture du béton armé."
[174] Jamot (see note 105), p. 8: "La façade ne fait pour ainsi dire que laisser transparaître l'ossature de la construction."
[175] Dormoy (see note 102), p. 163.
[176] Jamot (see note 105), p. 9.

béton armé in 1905 Jamot insisted on the continuity and coherence of Perret's work, minimizing any substantial change in the architect's own conception of either the material or its architectural embodiment.

On the notion of economy

Outlining the rules of Perret's aesthetic, Jamot stressed that if the architect's style was dominated by the vertical and the rectangle, this was not due to *a priori* choices but to an imperative internal logic. "Economy is the supreme law of architecture", Jamot wrote, adding: "The aesthetic of Perret can be synthesized in a few words: to do the best that is possible with the least possible means."[177] Because of his conception of "economy of means", Jamot stressed that Perret's approach -- recalling the thinking of Racine on art and its materials -- echoed the fundamental principles of any classical art.

Jamot's insistence on the "law of economy" echoed the preoccupations of the Beaux-Arts architects of Rationalist leaning. In a 1926 conference on the "aesthetic of reinforced concrete", the architect Paul Guadet -- then professor at the Ecole des beaux-arts -- stressed the importance of the notion of economy, while pointing to a current confusion in the understanding the notion.[178] Distinguishing between the financial economy of money and the theoretical economy of material, he argued that a truly rational aesthetic had to be based on the latter, a Rationalism that could best be achieved by the use of reinforced concrete.[179] Pursuing his analysis, Guadet questioned the idea that reinforced concrete could only give birth to straight, rigid forms. Since the rational

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[177] Jamot (see note 1), p. 644: "L'esthétique de Perret se résume en ces simples mots: faire le mieux possible avec le moins possible."

[178] Paul Guadet, "L'esthétique du béton armé" (conference given 11 February 1926 at the Cercle Artistique et Littéraire de Bruxelles), and published in L'Emulation, (Organe de la Société Centrale d'Architecture de Belgique), 1926.

[179] Guadet (see note 178), p. 4: "Voici, par contre, ce que j'entends par rationalisme dans la construction: c'est la recherche d'une oeuvre qui soit aussi économique que possible comme emploi de la matière, qui ne présente nulle part de la matière surabondante".

junction between vertical and horizontal elements was the ellipse, Guadet argued that the material also allowed the appropriate and harmonious development of the curve.[180]

Guadet's reflections are indicative of contemporary rhetoric on the economic use of concrete. The economic argument was commonly used in the analysis of Perret's architecture. But critics often exploited the ambiguity Guadet had pointed in the notion itself. In a discussion on the Raincy church, Mayer could insist on the impact of financial economy on both the design and the choice of rough-cast concrete. Conversely, Jamot could explain Perret's vertical style by his respect for the architectural "law of economy". This confusion was further encouraged by Perret's ambiguous status as both architect and builder. Indebted to the Rationalist conception of economy, these interpretations ultimately grounded Perret's practice of concrete construction in the logic of an architectural aesthetic, not in the logic of industrial production.

Perret and the *architecture du béton armé*

In her 1925 article on French modern architecture, Marie Dormoy claimed that the "stone age was over", and that architects were entering the "era of cement and reinforced concrete".[181] In his 1925 article on reinforced-concrete churches, Marcel Mayer argued that the examples presented were sure signs that contemporary architecture could soon be called the "reinforced concrete age".[182] By 1927, the notion of an *architecture of reinforced concrete* as a genuine genre was well established, a category first grounded in the belief that an architecture could be defined by the exploitation of a single material. Strikingly embodied in the Raincy church and the Grenoble tower, this idea received a broader recognition with contemporary publications like Le Ciment-roi, a catalogue of projects in which concrete was the sole material of construction, constituting skeleton,

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180 Guadet (see note 178), p. 5: "J'en arrive ainsi à pouvoir vous dire que l'emploi rationnel du béton armé, au lieu de donner des formes droites, rigides, sèches, permet au contraire de concevoir des bâtiments aux lignes harmonieuses puisqu'elles sont courbes et se relient parfaitement".
181 Dormoy (see note 102).
182 Mayer wrote: "Il se pourrait bien, pourtant, que notre classification prît le nom d'*âge du béton armé...*" Mayer (see note 128), p. 366.

form, and ornamentation at once.[183] It was an approach to concrete construction that was in line with the thinking of Henri-Marcel Magne.[184] In Le Ciment-roi, Perret offered the best description of the nature of a concrete construction: "A construction is in reinforced concrete when all its elements have been executed in concrete and when all other materials have been banned, that is to say, where concrete must be used rationally and without being clothed with any other material."[185]

The idea that reinforced concrete could be taken as the common denominator of a specific architectural genre was not limited to the French scene. During the second half of the 1920s the idea also gained currency outside France. With Architectural Design in Concrete, Thomas Bennett contributed to the definition of an international corpus of architectural works where the material served as a common denominator.[186] With The Ferro-Concrete Style, Francis S. Onderdonk examined the properties of reinforced-concrete construction, exploring the material's potential in the development of a new architectural style.[187] With Beton als Gestalter, Ludwig Hilberseimer and Julius Vischer reaffirmed the conception of the material as a generator of forms.[188] Emulating the turn-of-the-century publications on metal construction, these studies investigated the theoretical, formal, and aesthetic basis of architecture in reinforced concrete.[189] Given the assumed universality, adaptability, and flexibility of the material, the authors faced the task of defining its most appropriate forms. These studies tended to take the external manifestation of the material, the concrete, as the main criteria for the selection of works.

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[183] Le Ciment-roi, réalisations architecturales récentes, Paris, Librairie de la Construction Moderne (ca. 1926).

[184] Beginning with his 1919 article "L'architecture et les matériaux nouveaux" (Art et Décoration, vol. 36, May-June 1919, pp. 85-96), Magne developed the idea that the correct use of concrete enabled to achieve the synthesis between structure, form, and ornamentation.

[185] Le Ciment-roi, (see note 184): "Une construction n'est en ciment armé que quand tous ses éléments n'ont pu être obtenus que par le béton et alors que tout autre matériau peut être banni, c'est-à-dire là où le béton seul doit être rationnellement employé et sans habillage par une matière quelconque."

[186] Bennett (see note 158).

[187] Francis S. Onderdonk, The Ferro-Concrete Style, New York, 1928.

[188] Ludwig Hilberseimer, Julius Vischer, Beton als Gestalter, Stuttgart, Julius Hoffmann, 1928.

[189] See for exemple Alfred Gotthold Meyer, Eisenbauten, ihre Geschichte und Aesthetik, Esslingen, Paul Neff Verlag, 1907.

All three authors noted the contribution of France and especially the works of Perret in the development of reinforced-concrete architecture. Yet all three essays were primarily engaged in an examination of the architectural potential of the material, the formulation of universal criteria, not the consecration of a specific architect and his architectural work.

In France, however, the definition of the *architecture du béton armé* fulfilled another goal: the definition of a true French modernism. Thanks to the combined effort of a group of writers and critics, Perret was enshrined as the founder of the *architecture du béton armé*. Not merely the result of a positivist classification of architectural works, rather this genre was gradually defined through the debate taking place within French architectural circles. At first, architecture in concrete was primarily defined as a modern alternative to the "eclecticism" which plagued contemporary architectural practice, an alternative further reinforced in opposition to the Beaux-Arts and the academic establishment. Perret's architecture and practice challenged the conventions of the architectural establishment, yet it also attempted to renew the broken link with the mythical French tradition.

With A.-G. Perret et l'architecture du béton armé, Jamot offered the first synthesis of this cultural and ideological construction. The critical reception of Jamot's book provides further evidence that Perret was perceived as belonging to the French tradition. Most critics praised the study and the architecture of the Perrets. The book was especially well received by the proponents of the renewal of religious art in France.[190] Recalling Jamot's authority as a specialist of medieval and classical architecture, Paul Fierens claimed that Jamot revealed that "in architecture, nothing can run counter to logic, can go against a discipline imposed by matter, and, finally, tradition."[191] For these critics, Perret's *architecture du béton armé* could be understood as the modern version of the

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[190] See the articles of Maurice Brillant, Paul Fierens, and Raymond Regamey (Fonds Perret, 535 AP 334).

[191] Paul Fierens, "Les frères Perret et l'architecture du béton armé", Journal des débats, 2 August 1927: "Car rien de se fait en architecture à l'encontre de la logique, d'une discipline imposée par la matière et, pour tout dire, de la tradition."

medieval *Opus francigenum*. Within the framework established by Jamot and Mayer, Perret's modernism was presented in terms of a continuity with, not a rupture with, the authentic French tradition.

3. Modern Materials and the Nationality of Modern Architecture (1927/28)

By 1927, Auguste Perret had become a leading figure on the French architectural scene. The publication of Paul Jamot's monograph A.-G. Perret et l'architecture du béton armé proposed the first overview of the architect's work and cultural position. Published in the wake of the controversy that put Perret in opposition to the architectural establishment, the book endeavoured to reveal the architect's connection with the French architectural tradition. But Jamot's book was written not only to consolidate Perret's position before the architectural establishment, it also addressed the current debate on the definition of modern architecture in France. Jamot was engaged in demonstrating that Perret and France were at the source of modern architecture. With other critics, Jamot engaged in the critique of the internationalism of the French architectural avant-garde. The issue of modern materials was to play a central role in this demonstration.

On the critique of regionalism (1923-26)

The distinction between nationalism and internationalism in French architecture developed gradually during the 1920s. After the First World War, architectural circles focused on the problems raised by the reconstruction, one of which was the issue of regionalism. A large consensus developed among progressive architects that regionalist architecture should be rejected in favor of an architecture that would be more responsive to modernization in both society and construction. By 1927, the terms of this discussion had changed, and the consensus against regionalism gave way to an opposition between nationalism and internationalism. For some, the rejection of regionalism meant the recognition of a new level of identity and the development of a national architecture. For others, the breakdown of regional identity could only lead to internationalism in architecture. One issue in the construction of these competing definitions of modernism was materials.

In the early 1920s, both Auguste Perret and Le Corbusier took the position against regionalism. Both encouraged the development of an architecture freed from local characteristics. Perret's critique of regionalism in architecture dated back to 1917.[192] Central to his position was the claim that the use of reinforced concrete would give way to a European style that would certainly change in time, but would not be influenced by local variations. For some architects and critics, Perret's architecture announced the downfall of regionalism. In her 1923 article on the Perrets, Marie Dormoy wrote that "architectural regionalism was dead", and that the extensive use of the one truly modern material (reinforced concrete) would put an end to regionalism and regional styles.[193] This position was echoed in the discourse of Perret's young followers. Michel Roux-Spitz, a former student at the Ecole des beaux-arts and a Prix de Rome recipient, is a case in point. In a 1924 article dedicated to the architecture of Perret, Roux-Spitz could confidently announce the coming triumph of a new architecture "quasi-international and with very few variations between countries."[194]

Le Corbusier's critique of regionalism was also rooted in the context of the reconstruction. His theoretical proposal for mass-housing based on the exploitation of reinforced-concrete construction was a direct response to the contemporary praise of

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192 Fabre wrote: "Le régionalisme artistique a des adversaires et des partisans. Les protagonistes du ciment armé, comme M. Perret, lui sont résolument hostiles, estimant que ce nouveau procédé et celui du fer, qui nous font triompher des climats, par exemple dans la forme des toits, doivent fatalement entrainer sa disparition." Abel Fabre, "L'architecture régionale dans les régions envahies", La Croix, 29 January 1917.
193 Dormoy (see note 6), p. 416.
194 Michel Roux-Spitz, "L'architettura moderna in Francia", Architettura e Arti Decorative, vol. 3, no. 1, 1924, n.p.: "Così è prossima l'ora in cui trionferà una nuova architettura, quasi internationalizzata e con poche variazione da un paese all'altro..."

regionalism.[195] During the 1920s, Le Corbusier further pursued his discussion of regionalism in light of the notion of *standart*. With the development of new means of construction, the local architectural type was to be replaced by a new architectural standard.[196] The *standart* was a material form that resulted from a process of selection, a process analogically related to machine production, and that had given birth to the classical canons. Inspired by the models of the *société machinique*, Le Corbusier's new *standart* was to supersede any association with a national tradition.[197]

This is not to say that Le Corbusier was not concerned by issues of nationalism. During the 1910s, his whole perception of artistic production was framed by the critical comparison between French and German art and architecture.[198] Le Corbusier's and Ozenfant's concern for the national, not to say racial traits of artistic practices later reappeared in the pages of L'Esprit Nouveau in an article signed Paul Boulard.[199] But Le Corbusier's critique of German architecture was not aiming at the definition of an architecture that was either specifically French or that would have national characteristics. Inspired by developments that extended beyond national borders [the *société machinique*], he sought early on to define an architecture that possessed a universal character.

Toward an international modernism (1925-26)

After the war, the architectural avant-garde in Europe entertained the idea that the new architecture, by its very essence, had an international character. With the publication of

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195 See Le Corbusier-Saugnier, "Maisons en série", L'Esprit Nouveau, no. 13, December 1921; Vers une architecture, Paris, Crès, 1923, p. 189.

196 Le Corbusier, "Un standart meurt, un standart nait", Almanach d'Architecture Moderne, Paris, Crès, 1926, p. 83: "Des procédés neufs de construire peuvent, d'un coup, bouleverser *les moyens* et, par jeu de conséquence, les attitudes d'un régionalisme ancestralement raciné dans les bases d'un *véritable style*."

197 Le Corbusier wrote: "Grâce à la machine, grâce au type, grâce à la sélection, grâce au standart, *un style* s'affirmera." Le Corbusier, "Construire en série", Almanach d'Architecture Moderne (see note 196), p. 81.

198 See especially Le Corbusier's unpublished manuscript of 1915-16 entitled "France ou Allemagne" (Fonds Perret, 535 AP 317).

199 Paul Boulard, "Allemagne...", L'Esprit Nouveau, no. 27, November 1924, n.p.

Internationale Architektur in 1925, Walter Gropius became the spokesman for the idea of a possible internationalization of modern architecture.[200] For Gropius, the key to this internationalization rested first of all in the development of a "unified vision of the world" that inevitably had to result in the unification of external forms. This objectification of values, pushed by the universalization of commerce and technology, favored the unification of modern architectural characteristics. In France similar ideas were being discussed, but here the eventual development of unified forms was attributed to a determinant quite different from Gropius' axiological explanation. Strongly influenced by the Rationalist tradition, French architects and writers associated the issue of internationalism with the question of "new materials", and with reinforced concrete. Indeed, many associated the potential internationalization of architecture with the assumed "universalism" of the material.

In a conference given in February 1926, Robert Mallet-Stevens explained the cause of the new international architecture.[201] His reading of architectural history was largely inspired by Auguste Choisy: "It is the construction process that creates an architecture and not the decoration applied to it. We are often mistaken in our explanation of, I will not say the style, but the characteristic traits of a period."[202] In a curious analogy between a car engine and reinforced-concrete construction, Mallet-Stevens reiterated that fundamental esthetic changes were introduced to the house by this new building system.[203] With this new mode of construction, architecture was given "a new face": "The surfaces become smooth, the right angle dominates, the facades are clean, legible,

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200 Walter Gropius, Internationale Architektur, (Bauhausbücher no. 1), Munich, 1925. On this question, see Werner Oechslin, "Storia e stile in Gropius", Rassegna, vol. 5, no. 15, September 1983, pp. 10-12.

201 Robert Mallet-Stevens, "Les raisons de l'architecture moderne dans tous les pays", Conférencia - Journal de l'Université des Annales, vol. 20, no. 24, December 1926, pp. 585-597.

202 Mallet-Stevens (see note 201), p. 586: "C'est le procédé de construction qui crée une architecture et non pas la décoration qu'on y applique. On se méprend souvent sur l'explication, je ne dirai pas d'un style, mais des marques caractéristiques d'une époque."

203 Mallet-Stevens wrote: "Le moteur cet organe qui bouleverse tout, scientifiquement et plastiquement est à la voiture ce que le béton armé est à la maison: construction nouvelle, esthétique nouvelle." Mallet-Stevens (see note 201), p. 587.

and sincere".[204] The universality of the material was not presented as the sole cause of the internationalization of architecture. The uniformization of needs and customs was also taken as a determinant factor.[205] But in the course of his demonstration Mallet-Stevens did not hesitate to give the mode of construction a preponderant weight. Comparing works by Frank Lloyd Wright with and the Dutch architect Ferdinand Kramer, he wrote: "What is striking about these works is the search for horizontal lines, lines that are made possible only with reinforced concrete."[206]

By the mid-1920s the architect André Lurçat had also become an advocate of architectural internationalism. His contribution to the catalogue of the 1926 Exposition Nancy Paris is indicative of this commitment. Entitled "Architecture Internationale", his article drew an analogy between the great architectural periods and contemporary architecture: "As in the most rewarding periods of great construction (Roman, Gothic, renaissance), the effort is international. Each country brings its contribution and its personality. And this international movement, directed in the same spirit, is all the more solid because it is based on the constructional principle."[207] He further added: "Discovering the marvelous possibilities of new materials and industrialized elements, each one establishes his own technical and aesthetic laws."[208]

For Lurçat, this internationalism was deemed to find its expression in the development of similar forms. One of these forms was the flat-roof. In 1927, Lurçat was

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204 Mallet-Stevens (see note 201), p. 589: "On conçoit aisément que cette technique toute neuve donne à l'architecture un nouveau visage. Les surfaces deviennent unies, les angles droits dominent, les façades sont propres, lisibles et sincères."

205 Mallet-Stevens wrote: "A Los Angeles on construit comme à Amsterdam, et à Tokio comme à Paris. Les besoins sont les mêmes, les habitudes sont les mêmes, les matériaux, grâce au béton armé, sont les mêmes." Mallet-Stevens (see note 201), p. 591.

206 Mallet-Stevens (see note 201), p. 592: "Ce qui frappe tout de suite, c'est cette volonté de ligne horizontales, lignes que seul le béton armé permet de réaliser."

207 André Lurçat, "Architecture Internationale", Deuxième exposition annuelle du Comité Nancy-Paris, Exhibition catalogue, March 1926, n.p.: "Comme aux plus belles époques de grande construction (romaine, gothique, renaissance), l'effort est international. Chaque pays y apporte sa part de trouvailles et sa personnalité. Et ce mouvement international, dirigé dans un même sens d'esprit, est d'autant plus solide qu'il prit partout, pour point de départ, le principe constructif."

208 Lurçat (see note 207): "Chacun découvrant à l'épreuve les merveilleuses possibilités des matériaux nouveaux et des éléments usinés, établit ses propres lois techniques et esthétiques."

commissioned by a Frankfurt architect to write an article on "the flat-roof in international architecture".[209] Finally titled "the march towards the flat roof", Lurçat's article pointed to the similarity between modernist horizontal roofs and the architecture of Mediterranean civilizations.[210] In a subsequent exchange with Sigfried Giedion, Lurçat was to divide European architecture along cultural-geographic lines -- the Latins in the South and the Germans in the North -- giving the idea of internationalism a different dimension. For Lurçat, the development of international forms was ultimately linked with socio-cultural characteristics rather than technical determinants. Constructional principles were to provide the stable basis on which the new international forms could develop. But the acceptance of these forms was to depend on the state of development of each national tradition.[211]

The reaction against internationalism: the climate, the artist, the material

By the time of the 1925 Art Deco Exhibition, the opposition between regional and national had been replaced by a debate between defenders of a national modernism and advocates of an emerging internationalism in architecture. But the claims regarding the international character of modern architecture were met with skepticism by most French architects. An indication of this skepticism is provided by the Official Report on the architecture of the exhibition.[212] Henri-Marcel Magne, the author of the report, proposed an understanding of modern architecture as a movement that exploited the advances of industry and made use of contemporary materials and construction techniques to realize new architectural programs. Insisting on the relationship between modern materials and modern programs, Magne wrote that "the *material*, or if one prefers, the *apparatus* of

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209 Jean-Louis Cohen, "L'architecture d'André Lurçat (1894-1970): autocritique d'un moderne", vol. 1, doctoral dissertation, EHESS, Paris, 1985, pp. 266-267.

210 André Lurçat, "Der Weg zur Terrasse", in special issue, "Das Flache Dach", Das Neue Frankfurt, vol. 1, no. 7, October-December 1927, pp. 173-175. Cited in Cohen (see note 209), p. 266.

211 In his analysis of Lurçat's Architecture (1929), Cohen points to the architect's understanding of the new international architecture in light of French architectural culture and tradition. Cohen (see note 209), p. 326.

212 Rapport Général (see note 79).

modern architecture is without doubt reinforced concrete."[213] The author also noted that since reinforced concrete was a combination of substances that could be found in all countries, and could satisfy a variety of programs, its use tended to become universal. But -- Magne asked -- was the widespread use of the building system to give birth to a universal style? His answer was unambiguous: "Luckily, we have not reached this point. In addition to the impact of climates, the taste of races, of nations, individual tendencies maintain a great variety in architectural solutions and in the painted and sculpted decoration of buildings."[214]

In most writings inspired by the Rationalist paradigm, climate was often framed as a metaphor of the national character. In her review of French modern architecture, Dormoy underlined that architecture, being first a question of technique rather than aesthetic, the two determinant factors were the climate and the *matériau*.[215] Yet for Magne the national character of modern architecture was also indebted to the persistence of the habits and taste of men. He thus rejected Henry van de Velde's contemporary call for "a unique style without age and name", a "pure form", rationally conceived, and acceptable to all countries and for all times.[216] In this indirect exchange with Van de Velde, it was Magne who paradoxically insisted on the role played by the artist.[217] For the French writer, modern architecture was to vary, like needs and tastes, according to each country.

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213 Rapport Général (see note 79), p. 15: "Le *matériau* ou, si l'on préfère, *l'appareil* de l'architecture moderne est, sans contredit, le béton armé".

214 Rapport Général (see note 79), p. 20: "Heureusement, nous n'en sommes pas là. Sans même parler des climats, les goûts des races, des nations, les tendances individuelles maintiennent une grande variété dans les solutions architecturales, ainsi que dans la parure peinte ou sculptée des édifices."

215 Dormoy (see note 102), p. 161: "Ce qu'il faut admettre, c'est que l'architecture, avant d'être une question esthétique, est une question de technique; et que les deux facteurs importants du problème posé sont le climat et le matériau."

216 Rapport Général (see note 79), p. 20. Magne apparently refers to Henry van de Velde, Formules d'une esthétique moderne, L'Equerre, Bruxelles, 1923.

217 In the 1914 Deutscher Werkbund debate that opposed Van de Velde to Muthesius, it is the former who then insisted on the role of the creative artist in opposition to the idea of *typisierung* defended by the latter. On this debate, see Stanford Anderson, "Deutscher Werkbund - the 1914 debate: Hermann Muthesius versus Henry van de Velde", in Companion to Contemporary Architectural Thought, Ed. by Ben Farmer & H. Louw, London, Routledge, 1993, pp. 463-467.

Perret, reinforced concrete, and nationalism

By 1925, Perret's work and doctrine came to play an important role in the discussion on nationalism and modernism in French architecture. In 1926, Marcel Mayer discussed Perret's architecture in light of the question of regionalism, concerned by the impact of reinforced-concrete construction on the future of regionalist architecture.[218] Traditionally, he argued, architecture had been ruled by local climate and materials, but established practices were to be abandoned to fulfil the demand for economical and rapid construction. The adoption of reinforced concrete with its universal character, would thus change local architecture. Internationalism was also due to the increasing uniformization of habits and needs. What, therefore, was the future of regional or national styles? Even despite this uniformization, Mayer answered, the temperament of each country would nonetheless leave its imprint on the aesthetic of reinforced-concrete constructions.[219] Architecture would retain its national style: "The national or local taste endures and will endure enough to be clearly noticeable, and, under the influence of climates, constitute a new racial style".[220]

For both Marcel Mayer and Henri-Marcel Magne, the question revolved around the opposition between the universality of the building system and the nationality of the architecture. Mayer's insistence on the national tradition was supported by Perret's own allusions to the nationality of reinforced concrete. As already seen, Perret's theoretical discourse on building materials was tainted by a form of technological nationalism. In 1922, Perret stressed that the new cement invented during the war, *ciment électrique*, could really become the French material *par excellence*.[221] In a conference given in 1925,

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[218] Mayer (see note 140), p. 230: "Que devient le régionalisme architectural avec l'esthétique propre au béton armé ? La menace n'est-elle pas sérieuse de voir disparaître les styles régionaux ?" See also Mayer's unpublished manuscript [c. 1926] (see note 151).

[219] Mayer (see note 140), p. 232.

[220] Mayer (see note 140), p. 232: "Le goût national ou local subsiste et subsistera donc toujours assez pour être nettement remarquable, et, sous l'influence des climats, constituer un style de race nouveau."

[221] Jean Labadié, "Les cathédrales de la cité moderne", L'Illustration, vol. 80, no. 4145, 12 August 1922, p. 132.

Perret stressed that reinforced concrete was invented in France.[222] In an interview of 1926 with Guillaume Janneau, Perret declared that cement was a French discovery,[223] an idea given credit in Jamot's defence of Perret's project for the Sainte-Jeanne-d'Arc church.[224] Invented by a Frenchman, and first applied by French engineers, the material was unmistakably French. It is with these arguments that Jamot proceeded to the nationalization of the *architecture du béton armé*.

Perret and German architecture

In A.-G. Perret et l'architecture du béton armé, Jamot argued that the architecture of the Perret brothers, both modern and French, epitomized French modernism. Nationalism, the opposition between French and German modern architecture, provided the background for Jamot's argument. The connection of Perret's work with German architecture was not new. Since the completion of the Champs-Elysées theater in 1913, the Germanic character of the work had been recurrently underlined, and attacked by a number of critics. By then, accusations of *germanisme* implied the adoption of an art form that was both modern and internationalist in character, but these allusions were clearly indebted to nationalist tensions generated by the conflict with Germany. The reiteration of these accusations in 1925 was to reveal the new place assigned to Perret's architecture.

At the time of the Art Deco exhibition in 1925, Auguste Perret had a heated argument with the literary critic Jacques-Emile Blanche, triggered by Blanche's comment on the sources of the Champs-Elysées theater. In a long review of the Art Deco exhibition, Blanche wrote: "With the Champs-Elysées theater, the Perrets have

222 Auguste Perret (see note 59), p. 434.
223 Guillaume Janneau, "Les 'Moyens' nouveaux de la Construction", L'Exportateur Français, 27 May 1926 (Fonds Perret, 535 AP 330): "Les ciments, observez-le, sont une découverte française..."
224 Jamot (see note 109), p. 501: "C'est un Français qui l'inventa, il y a quatre-vingts ans et ce sont des ingénieurs français qui en ont fait les premières applications."

introduced at home the Germanic conception of a Hellenism adapted to modern life."[225] In a letter of reply to Blanche, Perret vehemently rejected any foreign, and especially Germanic, influence. Perret's argument was based on a theoretical reading of reinforced-concrete construction: "The interior and exterior aspect of the Champs-Elysées theater that we have built, as architects and builders, is wholly indebted to the general use of reinforced concrete."[226] Perret continued: "It is probably the use of the vertical and the straight line that encouraged some (reviewers) to perceive a Germanic influence in the theater. But this affirmation and repetition of the straight line is the result of an organic logic: it is imposed by reinforced concrete."[227] In conclusion, Perret reaffirmed that the theater was a "French classical composition", and that its modern aspect was the result of the logical use of reinforced concrete which, was a "French invention". For Perret, the French character of the theater was rooted not only in its formal composition, but also in its material substance.[228]

Though private, this exchange is indicative that by 1925 the sources of Perret's architecture was still a subject of debate. Perret's work was not necessarily perceived as a product of the French tradition. One of the tasks assumed by the circle of Perret's defenders was to assert the national character of his architecture. This task was taken up by Jamot. In the article defending the Sainte-Jeanne-d'Arc project, Jamot denied that Perret's architecture could have been influenced by German architecture.[229] For Jamot,

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225 Jacques-Emile Blanche, "Promenades à l'Exposition des Arts décoratifs. III", Nouvelles Littéraires, 18 July 1925: "Ceux-ci, cependant, ont introduit chez nous, avec le théâtre des Champs-Elysées, les conceptions germaniques d'un hellénisme adapté à la vie moderne."

226 Auguste Perret, letter to Jacques-Emile Blanche, 20 July 1925 (Fonds Perret, 535 AP 330): "Le Théâtre des Champs-Elysées que nous avons construit à la fois comme architectes et constructeurs, doit son aspect tant extérieur qu'extérieur à l'emploi généralisé du Béton de ciment armé."

227 Perret (see note 226): "Nous croyons apercevoir que ce qui a amené certains esprits à voir au Théâtre des Champs-Elysées des apports germaniques, c'est l'affirmation répétée de la verticale et de la ligne droite. Or, au Théâtre des Champs-Elysées, cette affirmation, cette répétition sont logiques organiques: c'est le Béton armé qui les impose."

228 In a letter dated 22 July 1925, Perret apologized for his insistence on the national question. The tone of his reply is telling of his sensitivity regarding the nationality of his architecture. In a later article, Blanche repeated some of Perret's argument. J.-E. Blanche, "Promenades à l'Exposition des Arts décoratifs. VI", Nouvelles Littéraires, 29 August 1925.

229 Jamot (see note 109), p. 501: "Il n'y a rien de germanique chez les Perret, absolument rien, et la seule ressemblance entre leurs oeuvres et celles des architectes allemands tient à ce que l'architecture du

the nationality of the material was reflected in the resulting architectural works. German architecture was given as an example: "Following the inclination of their national spirit, the Germans have used concrete to produce a colossal, cyclopean, massive architecture."[230] By contrast, Perret's architecture was viewed as elegant, light, aerial.

In a second article, Jamot substantiated his defence of Perret against the accusation of *germanisme*.[231] Invented in France, concrete was for a time ignored as a potential lever of aesthetic transformation, but it was Auguste Perret who, by logical deduction, invented the *architecture du béton armé*. For Jamot, Perret's reinforced-concrete architecture was characterized by verticals and naked surfaces. Despite its similarities with German works, this architecture was the result of a totally different process of conception. For Jamot, modern German architecture was derived from a preconceived aesthetic -- indebted to a peculiar "national psychology" -- which had very little to do with the principles of constructional Rationalism, as in Mendelsohn's Einstein tower, modeled in compact masses the way a sculptor models clay.[232] Modern architecture in Germany, Jamot claimed,*was not* an architecture of reinforced concrete. By contrast, Perret's conceptions were guided by the supreme law of architecture: economy. And concrete was the ideal material to realize this conception of art, which was both classical and French.

In a review of A.-G. Perret et l'architecture du béton armé, the literary critic Jean Prévost noted Jamot's excessive nationalism.[233] He was disturbed by a patriotism which could go so far as to negate any German influence on the history of reinforced concrete. Prévost argued that Jamot was in fact defending and confounding, two theses: the aesthetic of reinforced-concrete architecture, and the cause of Auguste Perret. Fully aware of the relative autonomy of these programs, Prévost shed some light on the book's

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béton, comme celle du fer, obéit à un minimum de règles générales, conséquences nécessaires du "matériau" employé."

230 Jamot (see note 109), p. 501: "Du béton, les Allemands, suivant la pente de leur espit national, ont tiré une architecture colossale, cyclopéenne, massive."

231 Jamot (see note 1).

232 Jamot (see note 1), p. 642.

233 Jean Prévost, "A. G. Perret et l'architecture du béton armé", Nouvelle Revue Française, November 1927, pp. 698-701.

underlying cultural strategy. While a testimony to the persistent antagonism between France and Germany, Jamot's monograph was chiefly an attempt to defend the preeminence of France and Auguste Perret in the development of modern architecture.

Perret's rupture with the avant-garde

In 1926, when Perret was engaged in a struggle with the academic establishment, he was also to enter into conflict with the critics close to the French architectural avant-garde. Perret's problematic status in the French modern movement is well illustrated by his changing place on the scene of architectural publications, a change highlighted by his rupture with Christian Zervos. In early 1926, Christian Zervos was actively engaged in the launching of the Cahiers d'Art. Perret knew Zervos, for in 1924 the young critic had interviewed him for an article on the architect.[234] In a letter to Perret dated 6 February 1926, Zervos explained the role Perret was expected to play: "I will use you as a regulator. Among the more abstract studies, I will introduce your work as a lesson in terms of logical research, of sensible construction, of rules.... I will take your work as a starting point of the new architecture and I will go to the forefront of all the new explorations."[235] Zervos' idea was to continue the practice inaugurated by Jean Badovici in L'Architecture Vivante. Invited to write the introductory page in the first issue of L'Architecture Vivante published in 1923, Perret was taken as the inspirational figure of the periodical. After a first exchange that was amiable, Perret turned aggressive when Zervos said he would also introduce the work of Van de Velde.[236] A rupture followed. In a reply to Perret, Zervos denounced the way the architect had attempted to impose his

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[234] Christian Zervos, "Réflexions d'Auguste Perret sur l'architecture", Les Arts de la Maison, Spring 1924.

[235] Christian Zervos, letter to Auguste Perret, 6 February 1926 (Fonds Perret, 535 AP 318): "Je me servirai de vous comme d'un régulateur. Parmi les recherches les plus abstraites, j'introduirai de temps à autre votre oeuvre comme une leçon de recherche raisonnée, de sens constructif, de règle... Je prendrai votre oeuvre comme point de départ de l'architecture nouvelle et j'irai au devant de toutes les nouvelles recherches."

[236] Christian Zervos, letter to Auguste Perret, 18 February 1926 (Fonds Perret, 535 AP 318).

own doctrinal program on L'Architecture Vivante and the Cahiers d'Art, two periodicals published by the Editions Albert Morancé.[237]

Perret's animosity towards Van de Velde -- which dated back to the Champs-Elysées theater -- is well known. Van de Velde had reappeared on the French architectural scene in the context of the discussion surrounding the origin of the tripartite stage of Perret's theater at the 1925 Art Deco exhibition.[238] Soon after, an excerpt from Van de Velde's book Devant l'architecture (1923) as well as an article by Badovici were published in the winter 1925 issue of L'Architecture Vivante.[239] The debate between Perret and Van de Velde was echoed by Werner Hegemann in the pages of a German periodical.[240] Perret's animosity was probably fueled by Van de Velde's recent interpretation of the new French architecture. In his recent book entitled Le nouveau style en France (1925), Van de Velde had focused on the theory and work of Le Corbusier, paying little attention to Perret's achievements.

It is around this time that Perret severed his relation with Jean Badovici, editor of L'Architecture Vivante. According to the account left by Le Corbusier, Perret told the publisher Albert Morancé that he should not tolerate the publication of Le Corbusier's work, for it destroyed the beautiful French tradition.[241] By 1926, Badovici was already pointing to Le Corbusier as the leader of the French modern movement. In an article

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237 Christian Zervos, letter to Auguste Perret, 19 February 1926 (Fonds Perret, 535 AP 318). Making reference to the debate Perret - Van de Velde, Zervos wrote: "A la réunion des architectes français et étrangers qui avait suivi la conférence de Berlage à la Sorbonne [November 1923] tout le monde était d'accord pour vous accuser au sujet du théâtre des Champs-Elysées. Seul j'ai essayé d'exalter vos qualités contre les architectes étrangers et contre vos amis qui vous tiraient perfidement dans le dos." Further: "On ne vous a jamais montré de l'humeur, ni Badovici ni moi, malgré la manière très violente dont vous avez voulu imposer à nos revues votre programme."

238 Marie Dormoy, "Réponse d'Auguste Perret à la brochure sur le théâtre du Werkbund à Cologne", L'Amour de l'Art, vol. 6, no. 7, July 1925, pp. 239-244. See also: Guillaume Janneau, "Auguste Perret et M. Van de Velde", Bulletin de la vie artistique, vol. 6, 1 September 1925, pp. 381-383.

239 Henry Van de Velde, "Devant l'architecture", L'Architecture Vivante, vol. 3, Winter 1925, pp. 24-26; Jean Badovici, "Entretiens sur l'architecture vivante. Henry Van de Velde", L'Architecture Vivante, vol. 3, Winter 1925, pp. 27-28.

240 Werner Hegemann, "Van de Velde, Chaos & les Danois", Wasmuth Monatshefte für Baukunst, December 1925. Perret's interest in the discussion is attested by the presence of a manuscript translation of the article in his personal archive (Fonds Perret).

241 Le Corbusier, annotation on the back of a sheet entitled "L'Esprit Nouveau", Fondation Le Corbusier, Paris (F2.13.164). Quoted in Gargiani (see note 4), p. 15.

entitled "Retrospective", Badovici reconstructed the evolution of the modern since the eighteenth century.[242] "In the twentieth century, architecture begins a new era. Cement imposes a return to elements and essentials truths."[243] Badovici situated the birth of reinforced-concrete architecture in 1903 with Perret's 25bis rue Franklin.[244] Illustrated with many of Perret's works, the article consolidated the view of Perret as a pioneer, but no longer a leader of the new architecture -- an interpretation that allowed Badovici to present Le Corbusier as "the last exponent of the present generation of young architects", the leader of the avant-garde.

The divergences between Perret and the advocates of the French modern movement were not merely personal but doctrinal. Personal differences only triggered the rupture and made Perret's criticism more acrimonious. Perret's break with Cahiers d'Art and L'Architecture Vivante is indicative of the changing configuration of the critical field.[245] Perret's work did not fit within the editorial program of Zervos, who was more oriented toward plastic experiments.[246] Neither did it fit within Badovici's evolving program, oriented toward international modernism. By 1926, Perret began to stand apart from the French modern movement. He was seen as a point of reference, but not a participant in the movement.[247]

Nationalism and Internationalism in French modernism

242 Jean Badovici, "Rétrospective", L'Architecture Vivante, vol. 4, no. 13, Fall 1926, pp. 5-7.

243 Badovici (see note 242), p. 7: "Au XXe siècle, s'ouvre une ère nouvelle pour l'architecture. Le ciment impose le retour aux éléments et aux vérités essentielles."

244 Badovici wrote: "En 1903, pour la première fois, l'oeuvre d'art, en béton armé, fut réalisée par les Perret qui ouvrirent ainsi en France l'ère des constructions économiques, élégantes et rationnelles et créèrent les types d'une simplicité de structure toute classique." Badovici (see note 242), p. 7.

245 For a brief analysis of the program of the two periodicals, see Hélène Jannière, "'L'Architecture Vivante' e 'Cahiers d'Art'", Casabella, no. 603, July-August 1993, pp. 46-53.

246 Jannière writes: "The position of the Cahiers d'Art was clear on the 'universal nature' of contemporary plastic language. Architecture was viewed as an expression, like painting or sculpture, of the pursuit of 'pure plastic values', the values which distinguished the art of the century". Jannière (see note 247), p. 49.

247 In 1924, Van Doesburg wrote: "Modern French architecture starts off with Auguste Perret (whom we could call the Parisian Berlage)." With this comparison, Van Doesburg framed Perret as a pioneer, not as a fully engaged participant in the modern movement. Theo van Doesburg, "Vernieuwingspogingen in de Fransche architecture", Het Bouwdedrijf, vol. 1, no. 4, October 1924, pp. 173-177.

In her 1923 review of Perret's architecture, Marie Dormoy had written that "The strength and thus the economy of reinforced concrete will make it universal and will create a universal style," adding that "the periods of great architectural styles are uniform and great architectural trends have always spread beyond climates and borders."[248] In the early 1920s, Perret shared with the emerging architectural avant-garde the belief in the universality of the new architecture that was to result from the use of reinforced-concrete construction. By 1927, however, this apparent consensus had given way to two radically divergent conceptions of both building materials and architectural modernism.

By the end of the 1920s, the belief that reinforced concrete would lead to the development of an international architecture was widespread, extending beyond the narrow limits of architectural circles. [249] Between 1923 and 1927, Perret and his circle were gradually to challenge this modernist assumption, contesting the idea that the universality of the material would necessarily give birth to an international architecture. For Perret and his circle, the goal was to reintegrate reinforced concrete within the French architectural tradition. Enshrined in the notion of *architecture du béton armé*, Perret's architecture had become the French response to international modernism. In the early 1920s, the debate on reinforced concrete had been linked with the critique of regionalism and the modernization of construction. By 1927, it had shifted to another realm: the more ideological debate on the nationality of modern architecture.

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248 Dormoy (see note 6), p. 416: "La puissance, et par là, l'économie du béton armé le rendra universel et créera un style universel." -- "Les époques de grand style sont uniformes et les grands courants architecturaux ont toujours passé à travers les climats et les frontières."

249 In a book devoted to interior decoration, Guillaume Janneau did not hesitate to sustain this assumption: "Or, les bétons sont des matériaux sans visages. Leur substitution aux pierres et même aux briques, n'aura-t-elle point pour effet de déterminer une sorte de style moderne international, dont les modules s'élaboreront en commun, et dans lequel s'effaceront progressivement tous les traits individuels ?" G. Janneau, Technique du décor intérieur moderne, Paris, Albert Morancé, 1928, p. 210.

CHAPTER V

REINFORCED CONCRETE AND THE AESTHETIC OF THE MODERN HOUSE (1922-1927)

In Theory and Design in the First Machine Age (1960), Reyner Banham underlines the *mystique* surrounding reinforced concrete in French architecture of the 1920s.[1] Pointing to the deterministic discourse of many writers, Banham attributes the belief in the determinant role of materials to the strong Rationalist tradition in French architecture, a tradition that led from Auguste Choisy to Auguste Perret: "This acceptance of Choisy's view of technique as a prime cause of style was doubtless encouraged by the dominating position of Perret as the sole innovator of consequence in the years immediately before the War...."[2] Perret's main contribution was to have advocated the trabeated structural frame later adopted by modernist architects, and to have left concrete an "aesthetically acceptable material" in the eyes of the younger generation.[3]

Banham rightly points to the concrete frame as a key technical characteristic of the new architecture. But he stops short of analyzing the exact nature and function of the frame in the conception and construction of the modern house. In this chapter, I examine the role of reinforced concrete in the definition of the aesthetic of the modern house in the 1920s, first considering how the aesthetic of the modern house came to be enshrined in the type of the undecorated cubic house in concrete, and focusing particularly on the construal and critical reception of the new architecture prior to the actual realization of any compelling example. Second, I study the place of reinforced concrete and the role of the frame in the conception and construction of the modern house, examining the technique

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1 Banham writes: "So powerful was the mystique of reinforced concrete in Paris by about 1920 that many French writers have accepted the idea that the new architecture of the twenties was in some way caused by this one material, rather than facilitated by it." Reyner Banham, Theory and Design in the First Machine Age, London, The Architectural Press, 1960, p. 202.

2 Banham (see note 1), p. 202.

3 Banham writes: "Though they paid frequent lip-service to the achievements of their immediate elders, their only real inheritance from these pioneers of reinforced concrete was Perret's preference for trabeated structural frames." Banham (see note 1), p. 202.

in light of the tradition of masonry construction. To do so, I focus on the works of Rob Mallet-Stevens and André Lurçat. Third, I examine Le Corbusier's changing conception of the frame, from his earlier emphasis on production (industrialization) to his later exploration of architectural expression (pilotis), to show how Le Corbusier exploited the frame to subvert the visual conventions of masonry architecture.

1. The Emerging Avant-garde and the Aesthetic of the Modern House (1922-1924)

At the end of the year 1924, the 17th Salon d'Automne (1 November-14 December) held at the Grand Palais was an important moment in the development of modern architecture in France. The architectural projects displayed by Le Corbusier and Pierre Jeanneret, André Lurçat,[4] Jean-Charles Moreux,[5] Bruno Elkouken,[6] Gabriel Guévrékian,[7] and Robert Mallet-Stevens [8] confirmed and consolidated the existence of a new architectural aesthetic. The formal unity of the projects exhibited was largely noted by the critics. For Louis Hautecoeur -- chief editor of L'Architecture -- almost all the architects that exhibited at the Salon d'Automne belonged to the same school: they all adopted the aesthetic proposed by Le Corbusier.[9] For the anonymous reviewer of Clarté, the exhibition was a key moment in the development of a new architecture, with Guévrékian,

[4] André Lurçat (1894-1970). Born in Nancy, trained at the Ecole des Beaux-Arts in Paris, from which he graduated in November 1923. Lurçat worked for the architect Henri Pacon from 1920 to 1924. See Jean-Louis Cohen, André Lurcat 1894-1970 Autocritique d'un moderne, Paris, IFA-Mardaga, 1995.

[5] Jean-Charles Moreux (1889-1956). First trained as an engineer of Public Works, Moreux entered the Ecole des Beaux-Arts in 1910, from which he graduate in June 1922. See Gilles Ragot, "Jean-Charles Moreux et la tradition française", report, Paris, IFA, 1988.

[6] Bruno Elkouken (1893-1968). Born in Poland, Elkouken arrived in Paris in 1920.

[7] Gabriel Guévrékian (1900-1970). Of Armenian origin, born in Istanbul and raised in Teheran, Guévrékian entered the Academy of Applied Arts in Vienna in 1915, from which he graduated in January 1921. He moved to Paris in 1921 and began working with Robert Mallet-Stevens in 1922. See Elizabeth Vitou, Gabriel Guévrékian 1900-1970, Paris, Connivences, 1987.

[8] Robert Mallet-Stevens (1886-1945). Born in Paris, Mallet-Stevens entered the Ecole Spéciale d'Architecture of Paris in 1903, from which he graduated in 1906. See Frédéric Seitz, L'Ecole spéciale d'architecture 1865-1930, Paris, Picard, 1995.

[9] Louis Hautecoeur, "Le salon d'Automne", Gazette des Beaux-Arts, vol. 66, 5th period, tome 10, December 1924, p. 348.

Le Corbusier, Lurçat, and Moreux hailed as the true pioneers of a sober, elegant, and rational art of living.[10]

The critical reception of the exhibition was indicative of the parameters developed to interpret the new architecture. Most telling was the review by Gaston Varenne published in L'Amour de l'Art.[11] Introducing the discussion with an evocation of Viollet-le-Duc, Varenne pointed to the "bold and realist spirit" of contemporary "builders". Modern architects were called "logicians" and their production was viewed as making no concessions to convention. From the outset, the reviewer was able to establish a natural connection between the use of new materials and the adoption of new forms. Varenne's description of the projects gives some indication of the current perception of modern houses: "These large naked facades, pierced with openings that look like prison windows, devoid of shutters or any external protection against the cold, the sun, these rectangular masonry cubes dominated by flat terrace roofs, these smooth walls, without a single molding to break the monotony, that could help our reading of interior levels, are disconcerting to both our logic and our taste."[12] The reviewer further asked: "Does concrete require such austerity ?"[13] From the outset, Varenne had identified the housing projects presented as being built of concrete or reinforced concrete. Yet, paying limited attention to technical issues, the construction system adopted was apparently taken for granted.

What seemed to be at stake was not the building system employed, but the external ornamentation that resulted from its use. Varenne was puzzled by the fact that although concrete was a material with great potential, architects tended to treat it without any

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[10] [Anonymous], "Salon d'Automne, I. La Section d'Architecture", Clarté, December 1924.

[11] Gaston Varenne, "Le Salon d'Architecture. L'Art Décoratif et l'Art Urbain", L'Amour de l'Art, vol. 5, no. 2, December 1924, pp. 369-376.

[12] Varenne (see note 11), p. 370: "Ces grandes façades nues, trouées de jours qui semblent des fenêtres de prison, régulièrement dépourvues de volets ou de toute protection extérieure contre le froid, le soleil, ces cubes de maçonnerie rectangulaires dominés par des toits plats en terrasse, ces murs lisses, sans une moulure qui rompe leur monotonie, qui fasse comprendre ou deviner l'agencement intérieur des étages, déconcertent quelquefois notre logique même, et plus encore notre goût."

[13] Varenne (see note 11), p. 370: "Le béton exige-t-il impérieusement une telle austérité ?"

external embellishment. For Varenne, the search for new modes of decoration was not to involve the imitation of modes developed for freestone architecture.[14] The problem, he argued, was to find new modes of decoration in order not to treat concrete as merely a "durable plaster". Making a direct reference to the material used by the sculptor -- an analogy borrowed from the philosopher Alain -- Varenne did not hesitate to equate the building material used by the architect with the *matière* of the artist. Though critical of the aesthetic of the modern house, Varenne offered a compelling summary of the key features that defined the new architecture: window openings, cubic forms, reinforced concrete, absence of decorative moulding.

Many of the projects presented at the exhibition took the form of small scale plaster models. Commenting on the event a few years later, Le Corbusier confirmed the importance of these models, stressing that their role was to present "to opinion the problem of the architectural aesthetic of reinforced concrete".[15] Varenne's analysis of modern houses had been based entirely on the examination of architectural models, not executed projects, for by the end of 1924 very few houses that accorded with the new aesthetic had been built. Le Corbusier had completed the construction of the villa Besnus at Vaucresson in 1923, and the atelier Ozenfant early in 1924. But the double villa La Roche-Jeanneret and the studios Lipchitz-Miestchaninoff were still under construction. Though Mallet-Stevens was currently building a villa for Charles de Noailles at Hyères, in the south of France, the construction of a villa at Mezy-sur-Seine had been interrupted. Lurçat had just completed the construction of a house at Eaubonne near Paris. But Moreux, Guévrékian, and Elkouken had not yet executed any of their own designs.

[14] Varenne wrote: "Il ne s'agit pas de réaliser avec le béton ce que permet la pierre de taille; il s'agit de trouver ici encore des procédés nouveaux de décor qui ne feraient pas du béton simplement "un plâtre durable". Varenne (see note 11), p. 370.

[15] Le Corbusier wrote: "Plusieurs maquettes de plâtre sont exposées à l'échelle de cinq centimètres par mètre: c'est une échelle qui permet de voir ce qu'on fait... Cette exposition de grandes maquettes permet de poser, devant l'opinion, le problème de l'esthétique architecturale du ciment armé." Le Corbusier, Pierre Jeanneret, Oeuvre complète 1910-1929, Zurich, Girsberger, 1937 [Zurich, Artemis, 1964], p. 59.

By the end of 1924, Le Corbusier was without doubt the most prolific architect of the group, in terms of both discourse and construction. His analysis of the Salon d'Automne published in L'Esprit Nouveau revealed what he considered to be the key issues of the new architecture.[16] While asserting that the exhibition had given clear signs of the birth of a contemporary architecture, Le Corbusier directly addressed the theoretical foundation of this new mode of expression: "We have shifted from the expression of the structure to the expression of plastic forms. Auguste Perret, who knows how to build, demanded that we show the structure. It was a healthy attitude. But an organism is not only made of bones, and a skeleton is a sad vision." [17] In contrast to Perret's emphasis on structural expression, Le Corbusier stressed that architecture was a matter of eurhythmics, of composition and harmony, and that technical and constructional factors were only one aspect of this broader quest. "The first goal of architecture", he wrote, "is to create a viable organism. The second, where modern architecture really begins, is to move our senses with forms that are harmonized and move our minds by the perception of mathematical combinations."[18]

But, Le Corbusier insisted, the construction of a viable organism was necessary for the production of "lawful" forms. The construction of this architectural organism was grounded in technique, in the work of the engineer. For Le Corbusier, a good architect had to be a good engineer. Behind this notion of "lawful" forms was the fundamental belief that forms without a sound constructional basis were merely deceptive. Making a veiled reference to the projects exhibited at the exhibition, Le Corbusier did not hesitate to

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[16] Le Corbusier, "Ce Salon d'Automne", L'Esprit Nouveau, no. 28, January 1925, pp. 2332-2335.

[17] Le Corbusier (see note 16), p. 2333: "On a passé de l'expression de la structure à l'expression des formes plastiques. Auguste Perret qui sait bâtir, demandait qu'on montrât les structures. Ce fut de la santé réintroduite. Le "mais" c'est qu'un corps n'a pas que des os et qu'un squelette rend triste."

[18] Le Corbusier (see note 16), p. 2334: "Primo. L'architecture c'est créer un organisme parfaitement viable. Secundo - et c'est vraiment là que commence l'architecture moderne - c'est émouvoir nos sens par des formes mises en harmonies et notre esprit par la perception des rapports mathématiques qui les unissent."

say that the models were seductive, and that the development of a new fashion was impending.[19]

The critical reception of the exhibition laid bare the state of perception of the new architecture. By 1924, the formal traits of the new architecture had been enshrined in the type of the undecorated cubic house in concrete. The belief that this new aesthetic directly derived from the possibilities offered by reinforced-concrete construction was widely shared. Yet the very nature of the material and its modes of implementation were rarely discussed. Most of the projects exhibited at the Salon gave few clues as to the mode of construction adopted. Except for Le Corbusier, who was actively engaged in the exploration of the possibilities and constraints of constructional techniques, most architects seemed to focus on the form rather than the technique of projects.

By the end of 1924, the new architectural aesthetic had come to be naturally associated with reinforced-concrete construction. This association was no doubt related to the post-war perception of concrete as the key material in the modernization of architecture. I would argue that this association must be understood in light of the few architectural exhibitions held in Paris between 1922 and 1924. In the following section, I analyze the critical reception given to exhibitions by both architects and critics, examining the central role of that response in drawing associations between new materials and the new aesthetic.

The 1922 Salon d'Automne

The first post-war event that testified to the emergence of a new aesthetic was the exhibition of the 1922 Salon d'Automne held at the Grand Palais (1 November-17 December). The Salon of 1922 saw the creation of the Section d'art urbain devoted to the exhibition of projects by architects, painters, sculptors and decorators. The goal of the

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[19] Le Corbusier (see note 16), p. 2334: "La séduction des maquettes sera grande, et une mode est imminante." The article was selectively illustrated with photographs of the small-scale models for the projects by Lurçat, Moreux, and Guévrékian.

Section was to encourage the unification of the various artistic practices devoted to the production of the contemporary "urban environment". Among the many projects presented in the Section, the ones of Robert Mallet-Stevens, Le Corbusier, and Adolf Loos retained the attention of critics. With the presentation of the Ville Contemporaine, Le Corbusier offered his first conspicuous statement on architectural modernity.[20] The exhibition provided architects and critics with a unique occasion to comment on the issues, principles, and values that were to command architectural conceptions. Two issues in particular seemed to recur in architectural discourse: the question of ornaments, and the question of materials.

Reflecting on the broader characteristics of "modern architecture", Henri Sauvage -- widely known for the conception of the stepped-terrace building built in 1912 in Paris -- wrote that current tendencies were dominated by the rejection of gratuitous decoration and by the ideal of clarity.[21] For Sauvage, external ornamentation had become useless because of speed and economy: "Only the main lines count, details become superfluous. It is the mass, the simple and understandable profile which will generate emotion and beauty."[22] The critique of ornaments -- and the corollary call for simplicity -- was not a new issue. In France, the publication in 1912 of Adolf Loos' lecture "Ornement et crime" merely confirmed the importance this issue assumed before the war.[23] The question of ornaments returned to center stage in the early 1920s and was given a new impetus in the theoretical work of Le Corbusier. Exploiting the arguments developed by Loos, Le Corbusier resumed the attack on the idea of artistic and architectural ornamentation.[24]

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[20] On this project, see Francesco Passanti, "The Skyscrapers of the Ville Contemporaine", Assemblage, no. 4, October 1987, pp. 53-65.

[21] Henri Sauvage, "Les Tendances de l'Architecture Moderne", L'Amour de l'Art, vol. 3, no. 10, October 1922, pp. 333-334.

[22] Sauvage (see note 21), p. 334: "L'ornementation extérieure devient donc inutile pour des raisons de vitesse et d'économie. Les grandes lignes comptent seules, les détails importent peu. C'est la masse, la silhouette simple et facilement compréhensible qui produira l'émotion et fera la beauté."

[23] Adolf Loos, "Ornement et crime", Cahiers d'Aujourd'hui, vol. 2, 1912.

[24] See Adolf Loos, "Ornement et crime", L'Esprit Nouveau, no. 2, November 1920, pp. 159-168. On this question, see Stanislaus von Moos, "Le Corbusier et Loos", L'Esprit Nouveau. Le Corbusier et l'industrie 1920-1925, Strasbourg, 1987, pp. 122-133.

If this issue was central to Le Corbusier's critical vision, it was also given great importance by a wide range of protagonists of the new architecture. The position developed by Robert Mallet-Stevens is a case in point. Inspired by the examples of industrial architecture, Mallet-Stevens argued in 1922: "The engineers, the architects who have built the factories have not attempted to give them the character of ancient monuments by means of an arbitrary decoration.... Only the utilitarian aspect has been taken into consideration; the large flat surface of the hall of machines, the giant (and smooth) chimney of the heating plant, the enormous cylinder of the reservoir are devoid of ornamentation."[25] Like Sauvage, Mallet-Stevens believed in the disappearance of traditional ornament, but while the former sought the source of this change in the perception of the modern city, the latter insisted on the lesson of modern industrial structures.

Mallet-Stevens' argument on the lessons of industrial architecture echoed that developed by Le Corbusier in L'Esprit Nouveau, or Henri-Marcel Magne in Art et Décoration. But his own work seemed to contradict such an anti-decorative position. It is at about the same time that Mallet-Stevens published Une Cité Moderne, a series of drawings depicting a collection of public and residential buildings (fig.65). Largely inspired by the architecture of Josef Hoffmann and the Viennese Secession, this "paper architecture" revealed a fundamental interest in ornamentation.[26] Both Sauvage and Mallet-Stevens were members of the newly founded Groupe des Architectes Modernes.[27] Critical of the traditional conception of applied ornament, the association demanded that

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[25] Robert Mallet-Stevens, Gazette des Sept Arts, vol. 1, no. 1, 15 December 1922: "Les ingénieurs, les architectes qui ont bâti des fabriques n'ont pas cherché par une décoration arbitraire à leur donner un caractère de monuments anciens... Le côté utilitaire seul a été envisagé, le grand pan uni du hall des machines, la cheminée géante et lisse de la chaufferie, l'énorme cylindre du réservoir n'ont aucune ornementation."

[26] Rob Mallet-Stevens, Une Cité Moderne (preface by Frantz Jourdain), Paris, Ch. Massin, 1922.

[27] The Groupe des Architectes Modernes was founded in October 1922. Among the founding members were the architects Frantz Jourdain, Hector Guimard, Henri Sauvage, Auguste Perret, and Louis Bonnier. Established to influence the architectural program of the Decorative Arts exhibition planned for 1924, the larger goal of the association was to lead the struggle in favor of the *moderne*. See Société des Architectes Modernes. Annuaire, Paris, 1934, p. 8.

its members "build according to the principles of modern aesthetics". But while the members rejected the traditional practice of ornamentation, the interpretation of the causes and "principles" of this modern aesthetic remained largely open.

Building materials as artistic *matière*

The second theme that reappeared in the critical reception of the exhibition was the question of building materials. Reviewing a project by the same Mallet-Stevens -- the pavilion of the Aéro-Club de France -- the critic Waldemar George reflected on the potential impact of materials on architecture.[28] From the outset, George argued that the history of architecture could not and should not be understood as the mere confrontation between materials and creative genius. But, he confessed, due to the discovery of reinforced concrete, which permitted one to treat masses more freely and at the same time defy the laws of gravity, architecture had entered a new phase of development.[29] The task of modern builders, exploiting the possibilities offered by the new material, was therefore to go beyond the mere demonstration of technical virtuosity to fashion a new style.

George's discussion figured within a larger debate on the sources of artistic creation. Challenged by the development of new materials and techniques, architects had to take a position with respect to their creative practice, which many did in the series of interviews published by Guillaume Janneau in the Bulletin de la Vie Artistique.[30] Some architects presented the material as the determinant force, a position best formulated in the

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[28] Waldemar George, "IV. L'Art Urbain", L'Amour de l'Art, vol. 3, no. 11, November 1922, pp. 358-362.

[29] He wrote: "Il serait sans doute injuste de considérer l'histoire de l'architecture comme un conflit séculaire entre les matériaux et le génie de l'homme prétendant les asservir au rythme de sa pensée, mais on ne peut nier que l'architecture soit entrée dans une phase nouvelle, depuis que la découverte du ciment armé permet de traiter plus librement les masses et de défier les redoutables lois de la pesanteur." George (see note 28), p. 359.

[30] Conducted by Guillaume Janneau, the interviews were published in 1923-24 in the Bulletin de la Vie Artistique in a series entitled "L'exposition des arts techniques de 1925. Que sera, demain, le logis? ".

interview with Mallet-Stevens.[31] Discussing a recent project by the architect -- a residence at Mezy-sur-Seine for the fashion designer Paul Poiret -- Janneau wrote that Mallet-Stevens' architecture was "like a sculpture", being conditioned by the "material".[32] The reviewer's interpretation found support in the architect's own comments: "The new architecture", Mallet-Stevens declared, "is precisely one that returns to principles.... The new architecture does not seek unusual forms for the sake of originality; it generates these forms out of the material itself, it submits to the material."[33]

Mallet-Stevens' belief in the primacy of materials was not shared by all protagonists. In another interview in the series, the interior decorator Pierre Chareau contradicted the architect's argument: "A certain doctrine subordinates architectonic forms to the nature of the *material*. This is a mistake. It is the mind which must command: *technicism*, may I say, is sterile."[34] Chareau's critique of determination by technique was undoubtedly directed against the pervading Rationalist rhetoric. Trained at the Ecole Spéciale d'Architecture, Mallet-Stevens had probably been influenced by the Rationalist discourse that conditioned the school's teaching in the early 1900s. But more importantly, this indirect exchange between Mallet-Stevens and Chareau is indicative of how differently architectural materials were weighed in the process of conception. For Mallet-Stevens, the material dominated that process while for Chareau, it was the mind of the artist that dominated the material. Yet both understood the creative process as the dialectical opposition of mind and matter. Following this philosophical conception of the

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31 Janneau, "L'exposition des arts techniques de 1925. Que sera, demain, le logis ? - III", Bulletin de la Vie Artistique, vol. 4, no. 11, 1 June 1923, pp. 229-231.

32 Janneau wrote: "Les travaux déjà réalisés témoignaient d'une conception absolument nouvelle, d'un parti franc et net, et d'une rigueur logique dont l'expression fournit à *l'architecture du béton armé* ses plus beaux effets... Son architecture est en effet sculpturale. Elle est conditionnée par le 'matériau', dont elle fournit l'expression plastique. Elle est rationnelle et rationaliste, ce qui crée encore de la clarté." Janneau (see note 31), pp. 229-230.

33 Mallet-Stevens, in Janneau (see note 31), pp. 230-231: "L'architecture *nouvelle* est précisément celle qui retourne aux principes... L'architecture nouvelle ne cherche pas des formes inédites pour affecter de l'originalité; elle dégage ces formes du matériau lui-même, elle les subit."

34 Janneau, Bulletin de la Vie Artistique, vol. 4, no. 19, 1 October 1923, pp. 414: "Une certaine doctrine, observe d'ailleurs M. Pierre Chareau, subordonne les formes architectoniques à la nature du *matériau*: C'est une erreur. Le matériau n'est qu'un moyen. C'est à l'esprit de commander: le *technicisme*, si j'ose dire, est stérile."

creative process, the question of *material* was thus framed in artistic, not architectural terms.

Mallet-Stevens' conception of building materials was clearly spelled out in a 1922 article in which he noted the positive mutual influence between architects and sculptors. "Their conceptions", he wrote, "are the same. The sculptor builds by means of planes while the architect seems to cut his house from a block. Perfect harmony. When the Perret brothers, Tony Garnier, Jeanneret, or Van Doesburg build, they build giant sculptures; light plays on the large surfaces the way it lights a stone by Laurens or a low-relief in metal by Miklos."[35] The comparison between architecture and sculpture was reiterated in 1923, supplemented by an allusion to the role of modern materials. Discussing the impact of reinforced concrete, Mallet-Stevens argued that this building system would trigger the disappearance of all applied decoration: "It is the house itself which becomes the decorative motif, based on its volumes and its forms, like a beautiful piece of sculpture."[36]

That reinforced concrete had become the key "material" in this artistic and dialectical opposition between mind and matter is best illustrated by a contemporary comment written by the French philosopher Alain. In a brief essay entitled "Matière et Forme", Alain commented on the nature of reinforced concrete, noting sadly that reinforced concrete was incapable of beauty, and this despite being a *matière* well suited to responding to the artistic "idea".[37] This subsumption under the general category of *matière* validated the current "artistic" conception of architectural materials.

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35 Mallet-Stevens (see note 25): "Leurs conceptions sont les mêmes. Le sculpteur construit par plans comme l'architecte paraît tailler sa maison dans un bloc. Harmonie parfaite. Quand les frères Perret, quand Tony Garnier, quand Jeanneret, quand Van Doesburg construisent, ils édifient de géantes sculptures, la lumière joue sur de vastes surfaces comme elle éclaire une pierre de Laurens ou un bas-relief en métal de Miklos". Mallet-Stevens' comment was also reported in Comoedia, 3 March 1923.

36 Janneau (see note 31), pp. 229-231: "C'est la maison elle-même qui constituera le motif décoratif, comptant dans l'atmosphère par ses volumes et par ses formes, comme un beau morceau de sculpture."

37 Alain wrote: "Le ciment armé ne donne rien de beau; ce n'est qu'un plâtre durable. Pourtant si quelque matière obéit à l'idée, c'est bien celle-là." Alain, "Matière et forme" [24 August 1921], in Préliminaires à l'esthétique, Paris, Gallimard, 1939, pp. 93-94.

The equivalence between architectural and artistic materials was widely recognized by architects and critics alike. This conception is best illustrated in the early work of the architect and architectural writer Jean Badovici.[38] In a book on the architecture of Charles Plumet published in 1923, Badovici argued that his architectonic compositions, like those of the ancient masters, were essentially based on the constraints of construction.[39] Badovici wrote: "The architecture is alive because it is first of all conditioned by matter [*matière*]. Art arises upon craft, like the flower on the plant; the artist is first a craftsman."[40] Badovici's phrasing is important, for it hinted at the expression *architecture vivante*, the title of the architectural journal he began to edit in 1923.[41] Badovici understood the architect's work on *matière* in terms of the relationship between art and craft, revealing how the Rationalist view of the role of building materials could be associated without apparent contradiction with the more artistic idea of *matière*.

This equation, however, was obviously problematic. The pigments of the painter or the clay, plaster, or stone of the sculptor were radically different from the constructional materials of the architect, in that architecture, unlike painting or sculpture, was defined by its dual nature as construction as well as art. To talk about building materials in architecture was therefore to talk about structure and form, internal coherence and external appearance. Yet many architects and critics did not hesitate to assimilate the *matière* of the artist and the *matériau* of the architect, an identfication that had an important

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38 Born in Romania, Jean Badovici (1893-1956) studied in the ateliers Guadet and Paulin at the Ecole des Beaux-Arts, and then at the Ecole spéciale d'architecture from which he graduated in 1919. Badovici was a member of the Groupe des Architectes Modernes, and the director of L'Architecture Vivante from 1923 to 1933, published by Albert Morancé. On Badovici, see Pierre Saddy, "Badovici (Jean)", Le Corbusier une encyclopédie, Paris, Centre Georges Pompidou/CCI, 1987, pp. 57-59.

39 Largely inspired by the architecture of the medieval period, Charles Plumet was representative of one trend within the French Rationalist tradition. Jean Badovici, Maisons de rapport de Charles Plumet, Paris, Albert Morancé, 1923.

40 Badovici (see note 39): "L'architecture est vivante parce qu'elle est d'abord conditionnée par la matière. L'art vient se superposer au métier, comme la fleur à la plante; l'artiste est d'abord artisan."

41 The notion of *matière* also appears on the introductory page of the first issue of L'Architecture Vivante. Written by Auguste Perret, the note reads: "L'Architecture Vivante est celle qui exprime fidèlement son époque. On en cherchera des exemples dans tous les domaines de la construction. On choisira les oeuvres qui, strictement subordonnées à leur usage, réalisées par l'emploi judicieux de la matière, atteindront à la beauté par les dispositions harmonieuses des éléments nécessaires qui les composent."

impact upon the inscription of reinforced concrete in the architectural culture of the 1920s.

Models as Architecture

The definition and perception of the new architecture was greatly conditioned by the way architectural projects were presented to the public. By the time of the 1923 Salon d'Automne (1 November-16 December), architectural models had become the privileged mode of presentation of projects, a fact largely accounted for by the creation of the section d'Art urbain at the 1922 Salon d'Automne. Architectural exhibitions being generally less accessible than the other arts, the organizers conceived the new section as a display of architectural models. Most of the projects were exhibited either as full-scale fragments built of *staff* or as small-scale models -- among them, a plaster model by Le Corbusier: the maison Citrohan (fig.66).

At the next Salon d'Automne, many projects again took the form of small models, among them models by Adolf Loos, Le Corbusier and Pierre Jeanneret, Walter-René Fuerst, Gabriel Guévrékian, and André Lurçat. With Pierre Jeanneret, Le Corbusier exhibited three models which exemplified his architectural approach: the double villa La Roche-Jeanneret, the villa Besnus, and the maison Ribot.[42] While the first two were commissions that were either completed or scheduled for construction, the last was a theoretical project for low-cost housing (the maison Ribot being conceived as a unit to be multiplied as row housing) (fig.67).[43] According to the available drawings, the vertical

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[42] In his review of the exhibition, Gabriel Veissières mentions the presence of four models and reproduces photographs of two: the villa Besnus and maison Ribot. However, the catalogue of the exhibition refers to only three models, suggesting that Veissières probably counted the model of the double villa La Roche-Jeanneret as two *maquettes*. See G. Veissière, "Le Salon d'Automne", L'Architecture, vol. 37, no. 23, 1923, p. 373. On this question, see Giovanni Fanelli, Roberto Gargiani, Perret e Le Corbusier confronti, Roma-Bari, Laterza, 1990, p. 150.

[43] According to the plans preserved at the Fondation Le Corbusier, the maison Ribot is conceived as a row housing unit. The intention inscribed in the plans is however contradicted by the rectangular window on the second floor of the side elevation that is present in the plaster model presented at the Salon d'Automne. Moreover, the rectangular window that appears on the side elevation drawing seems to have been added later. See The Le Corbusier Archive, vol. 1, pp. 467-469. See also Brian B. Taylor, Le Corbusier at Pessac, exh. cat., Harvard University and Fondation Le Corbusier, Paris, 1972, p. 9.

structure of the maison Ribot was based on lateral load-bearing masonry walls complemented with two reinforced-concrete posts on the inside. The front and back walls were to be made of a masonry infill. Though depicting a unit linked with the idea of mass housing, the plaster models said very little about the constructional system adopted.

By contrast, the two villa projects were actual commissions. The double villa La Roche-Jeanneret was still in conception phase,[44] and was presented in the form of a plaster model specially commissioned for the exhibition (fig.68).[45] Two plans placed under the model completed the presentation of the project. The villa Besnus at Vaucresson had just been completed, and the plaster model was (apparently) accompanied by photographs of the executed project. The architect evidently did not consider the photographs a proper substitute for the model, and seemed to give precedence to the models over drawings or photographs in the presentation of the projects. That choice is revealing, for the plaster models underlined the formal similarities between the projects presented, while providing little indication of the exact building materials and techniques involved.

The impact of Le Corbusier's models was duly noted by many reviewers. Writing in Paris-Journal, a journal of art, culture, and politics, Guillaume Baderre presented an interview with Auguste Perret, who commented on the architecture exhibited.[46] From the outset, Baderre wrote: "The numerous models presented by MM. Le Corbusier and Jeanneret have triggered the discussion, these architects having a very new technique which unsettles all traditions".[47] Highly critical of the projects presented, Perret did not

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44 For an analysis of the project's evolution, see Bruno Reichlin, "Le Corbusier vs De Stijl", De Stijl et l'architecture en France, (ed. by Yve-Alain Bois, Nancy Troy), Liège-Bruxelles, Mardaga, 1985, pp. 91-108.

45 Pierre Jeanneret, letter to La Roche, 22 October 1923 (FLC): "J'ai l'honneur de vous accuser réception de la somme de 300 Frs. à valoir sur maquette exécutée par Monsieur Lasnon, mouleur à Malakoff." (Cited in Reichlin [see note 44], p. 107).

46 Guillaume Baderre, "M. Auguste Perret nous parle de l'Architecture au Salon d'Automne", Paris-Journal, vol. 37, no. 2478, 7 Decembre 1923, p. 5.

47 Baderre (see note 46), p. 5: "Les nombreuses maquettes présentées par MM. Le Corbusier et Jeanneret ont surtout soulevé les discussions, ces architectes ayant une technique très neuve qui bouscule toutes les traditions."

hesitate to evaluate the new architecture in light of the "sternness" of the models.[48] Despite the presence of other presentation media, it is the models that attracted the attention of architects and reviewers.

The impact of these models can be further measured in light of the critical reception of the exhibition. Most critics concentrated on the formal resemblance of the projects: cubic volumes, undecorated flat surfaces, roof terraces, symmetrical openings, absence of cornices.[49] As such, the projects were viewed as the manifestation of a new architectural approach based on geometry, simplicity, and the absence of ornament, not as experiments in building materials and methods. In his review of the exhibition, Yvanhoé Rambosson rightly noted that Le Corbusier's projects were based on the use of modern materials. "Le Corbusier", he wrote, "has understood some of the improvements the use of reinforced concrete has introduced in to the construction field.".[50] The critic deciphered the impact of the new construction method as specific architectural features of the projects: the presence of roof terraces, the absence of cornices. He could not, however, identify the degree of experimentation involved in the construction process itself.

Architectural models and the definition of the "new architecture"

The models exhibited at the 1923 Salon d'Automne were not all made of the same materials -- André Lurçat's model for the "Maison pour Monsieur X" was made of wood and cardboard.[51] Yet many of the small scale models exhibited were in plaster, following the tradition of architectural modelmaking in France. Plaster models were usually made in

48 Responding to Perret's critique, Le Corbusier noted that he should have read the two plans placed under the model. In Guillaume Baderre, "Une visite à Le Corbusier-Saugnier", Paris-Journal, 14 December 1923.

49 See especially Gaston Varenne, "L'Art urbain et le mobilier au Salon d'Automne", Art et Décoration, tome 44, December 1923, p. 164.

50 Yvanhoé Rambosson, "Le salon d'Automne. III. Les Arts appliqués", L'Amour de l'Art, vol. 4, no. 11, November 1923, p. 745: "M. Le Corbusier a cependant saisi certaines des améliorations que l'emploi du béton armé pouvait introduire dans la construction."

51 Cohen (see note 4), pp. 23-24. In January 1924, Lurçat presented a series of four house projects at the Galerie Mosser in Nancy. The models were apparently made of painted wood and/or cardboard.

the context of public projects for monumental architecture, as revealed by the various models made for the Champs-Elysées theater (1911-13). These models played a key role in the process of defining the theater's facade, plaster models of the proposed facades being submitted to the Design committee of the theater's Board of directors (fig.69). It was on the basis of these models that the facade was modified, and Van de Velde's early design was merged with Perret's. The models were thus used to inform and enlighten the client, not used as tools of conception but as means of representation. This practice accorded with the academic tradition, where models were excluded from the conception process.[52]

During the early 1920s the young radical architects did not break with the representational function assigned to models; change took place at other levels. In the context of the Salon d'Automne, however, the models changed addressee. Shifting from the realm of the private client to the domain of the public exhibition, the models served to "display" the new aesthetic program. A second notable concerned building types, since until the 1920s plaster models had usually been made for monumental architecture. At the Salon d'Automne exhibitions, models were used for more modest building programs, and for the display of architectural innovation and experimentation.

The models were not used for the conception of the houses, only for their "public display".[53] Most often, they were not conceived as a complement but as a substitute to the presentation drawings. The models served to present the general configuration of the project, giving only a limited quantity of information regarding its material nature. This abstraction of the project's material constitution is most obvious with the plaster models, for plaster tended to unify the material heterogeneity of the virtual building into a homogeneous entity. The plaster model of the villa Besnus is a case in point. As

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[52] Gérard Monnier, L'Architecture en France. Une histoire critique 1918-1950, Paris, Philippe Sers, 1990, p. 259.

[53] Monnier suggests: "Ces maquettes ne sont en rien des éléments dans la conception d'un projet, elles sont produites pour autant qu'on puisse le savoir, comme résultat d'une étude, dont elles sont la représentation la plus spectaculaire possible." Monnier (see note 52), p. 260.

windows were made of the same material as walls, the model was influential in the perception of the house as a homogeneous masonry or reinforced-concrete block.

The homogeneity of the plaster models was further enhanced by the uniform whiteness of their surfaces. While this whiteness was due to the color of the plaster, it also coincided with Le Corbusier's call for the use of whitewash in architecture: "If the house is all white, the contour of things is highlighted; the volume of things appears clearly: the color of things is categorical. Whitewash is absolute.... Whitewash is extremely moral."[54] Le Corbusier strongly believed in the purifying quality of the white external surface.[55] For him, the problem was less material than moral, but its impact on the perception of the new architecture was determinant. At the formal level, it encouraged the assimilation of the model with the built form; At the level of materials and technique, it helped blur the distinction between masonry and reinforced-concrete construction.

The De Stijl exhibition

The role played by architectural models in the definition of the "new architecture" must be further examined in light of a contemporary event: the exhibition of the De Stijl group presented at the Galerie "l'Effort Moderne" in Paris in the Fall of 1923 (15 October-15 November). Organized by Theo van Doesburg, this exhibition presented the most recent experiments by De Stijl architects, also including works by J.J.P. Oud (a former De Stijl member) and a project by Ludwig Mies van der Rohe. Though the 1923 exhibition had a

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54 Le Corbusier, "Salon d'Automne: architecture", L'Esprit Nouveau, no. 19, December 1923, n.p.: "Si la maison est toute blanche, le dessin des choses s'y détache sans transgression possible; le volume des choses y apparaît nettement: la couleur des choses y est catégorique. Le blanc de chaux est absolu, tout s'y détache, s'y écrit absolument, noir sur blanc; c'est franc et loyal... Le blanc de chaux est extrêmement moral."

55 He wrote: "Et c'est là une nécessité morale plus encore que matérielle. Il faudrait établir la loi du blanchiment. Cette propreté fait voir les objets dans leur vérité sincère: d'où l'obligation d'une pureté parfaite. Retenons le terme: il définit toute une discipline. Il implique une certaine nudité." Le Corbusier, in G. Janneau, "L'Exposition des arts techniques de 1925. Que sera, demain, le logis?", Bulletin de la Vie Artistique, vol. 4, no. 3, 1 February 1923, pp. 64-65.

limited audience, it was to have an important influence on the Parisian avant-garde.[56] For Le Corbusier, the primary impact of the De Stijl exhibition was to trigger discussion on the use of color in modern architecture.[57] Bruno Reichlin has convincingly demonstrated that van Doesburg's and van Eesteren's projects played a key role in Le Corbusier's subsequent search for the dematerialization of architecture.[58] Yet at the end of 1923, the primary influence of the exhibition lay in its presentation of the new architecture as a formal practice.

The exhibition's chief emphasis was the architecture of Theo van Doesburg and Cornelis van Eesteren, who exhibited three projects -- the Hôtel particulier, the Maison d'artiste, and the Maison particulière -- in drawings and small-scale models. Architectural models again played a key role in the presentation: the Hôtel particulier was represented by a series of drawings and a large white model (fig.70),[59] while the Maison particulière was represented by a colored model along with a series of axonometric and analytic drawings called abstract compositions. The absence of a legible structural system, coupled with the exploitation of features like cantilevers and corner windows, encouraged the perception of the Maison as an object freed from the forces of gravity. The Maison d'artiste pushed further the experiment conducted on the Maison particulière, appearing as an elaborate model with a structure of welded copper and inserted plans made of glass, mica, and painted cardboard on a base of wood.[60] With a model that reached a high level of plastic abstraction, the Maison d'artiste seemed to negate the static axis of traditional constructions. The house seemed indifferent to current technical possibilities and the feasibility of its construction. Though the projects by van Doesburg and van Eesteren

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56 For a compelling analysis of the exhibition and its impact on French architecture, see Yve-Alain Bois, Nancy Troy, "De Stijl et l'architecture à Paris", De Stijl et l'architecture en France, Liège-Bruxelles, Mardaga, 1985, pp. 25-90.
57 Le Corbusier (see note 54).
58 This question is discussed in section three of the present chapter. See Reichlin (see note 44).
59 The model was apparently left white because of the lack of time to add colors, confirming the fact that it was conceived independently of color. See Bois, Troy (see note 56), p. 37.
60 Bois, Troy (see note 56), p. 44.

dominated the exhibition, works of domestic architecture by J.J.P. Oud and Jan Wils also appeared. Oud contributed three unexecuted projects: the Maison au boulevard de plage (1917), the Maison de campagne (1921-22), and the Projet d'usine (1919), presented in photographs of drawings. Based on undecorated cubic forms, these projects recalled some of the features of contemporary French architecture.

In a brief review of the exhibition, Gabriel Veissière -- the critic of L'Architecture -- noted that the proposed buildings were conceived solely with horizontal and vertical elements, that they were to be built entirely in reinforced concrete.[61] Veissière made this assumption in the absence of any indication by the exhibitors. The reviewer further added that the small-scale models offered no clue as to how the primary elements would be assembled: "we are not told how the cement rectangles placed vertically or horizontally attached to one another, and what are their respective thicknesses."[62] The lack of indications regarding the building method to be adopted was not surprising. Van Doesburg was critical of the current veneration of the engineer. He wanted to stress that the practice of architecture was to be rooted in creation and plastic research, not in the activity of construction.[63] Against traditional architecture, founded on the relation between support and weight, van Doesburg sought to develop an architecture liberated from gravity. Veissière's assumption regarding the building material adopted for the "contre-constructions" is an indication of the association of modern architectural experiments with reinforced-concrete construction.

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61 G. Veissière, "Les Architectes du groupe 'Styl'", L'Architecture, vol. 36, no. 22, 25 November 1923, p. 370: "Les maquettes sont construites en petites planchettes de bois peints horizontales ou verticales; il n'y en a point de posées dans un autre sens. Tout est à construire en ciment armé: sols, murs et plafonds, terrasses."

62 Veissière (see note 61), p. 370: "Même incertitude sur les procédés de construction; on ne nous dit pas comment ces rectangles de ciment posés verticalement ou à plat, tiennent les uns sur les autres, ni quelles sont leurs épaisseurs respectives."

63 In the De Stijl program, Mondrian called for the need to liberate architecture from "the tragic aspect of construction". (De Stijl, 1922). And Van Doesburg's taxonomy of modern architecture neatly separated constructive and utilitarian architecture from creative architecture." (De Stijl, March 1923). See Theo van Doesburg, Scritti di arte e di architettura, edited by Sergio Polano, Roma, Officina Edizioni, 1979.

Despite the radicalism of van Doesburg's and van Eesteren's experiments, Veissière did not hesitate to place them in the category of the "cubic house". The art critic Jacques Mesnil -- a harsh critic of Auguste Perret's architecture ever since the construction of the Champs-Elysées theater -- likewise viewed the projects as an architecture of "cubic blocks".[64] What this surprising association of a-tectonic, planar compositions with cubic forms suggests is the tendency to understand the new architecture on the French paradigm, the critical reception of the De Stijl projects confirming the perception of the new architecture as explorations at the formal not the constructional level.

The 1924 exhibition at the *Ecole spéciale d'architecture*

The model as the preferred mode of presentation of architectural projects was quickly adopted by the young radical architects. By 1924, it had already become the privileged vehicle for the presentation of the "new architecture". This practice was clearly confirmed by the exhibition presented at the Ecole spéciale d'architecture in the Spring of 1924 (22 March-30 April).[65] Entitled "L'architecture et les arts qui s'y rattachent", the exhibition was organized by Robert Mallet-Stevens, professor at the Ecole spéciale d'architecture since 1923. It was placed under the patronage of Paul Léon, commissioner of the Beaux-Arts, and Fernand David, commissioner of the Decorative Arts exhibition planned for 1925.[66] The scope of the exhibition was broad, for if it was devoted chiefly to architecture it also included works by painters, sculptors, and decorative artists, and it represented the works of the emerging avant-garde as well as those of more established architects like Tony Garnier and Auguste Perret. It also included works by Mallet-

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[64] Jacques Mesnil, "Les expositions", L'Humanité, 28 October 1923, p. 3 (Cited in Bois, Troy [see note 56], p. 50).
[65] For a thorough analysis of the exhibition, see Bois, Troy (see note 56), pp. 55 ff.
[66] See Robert Mallet-Stevens, "Une prochaine exposition française de maquettes d'architecture moderne", Comoedia, 9 February 1923.

Stevens' architecture students and by the De Stijl architects previously exhibited at the Galerie L'Effort Moderne.

Most of the participants exhibited models, following the practice encouraged at the Salon d'Automne. This use of models was duly justified by a contributor to the exhibition. Writing in the school's bulletin, Pierre Urbain argued that since a building occupies a volume in space, like a statue, it is logical to study it in space, by means of models.[67] "This method", he wrote, "is the only one that can give to a construction the plastic beauty that planar representation is incapable of creating, even with the most sophisticated rendering...."[68]

This event must be understood in light of Mallet-Stevens's earlier proposal to organize a major exhibition of models of French modern architecture. Writing in Comoedia in February 1923, Mallet-Stevens declared: "The 1925 International Exhibition of Decorative Arts is supposed to present French modern architecture to the world. The public is unaware of the existence of a modern architecture.... [The public] wants to be informed of the research of architects, to be introduced to the new forms of construction."[69] Invoking the need to enlighten the public, Mallet-Stevens proposed to organize an exhibition of "models of modern architecture" that was to be promoted by the Groupe des Architectes Modernes. The list of expected participants mostly derived from the group's membership, not from the emerging avant-garde, but when it materialized a year later in the context of the Ecole spéciale exhibition, the project had taken a different direction.

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67 Pierre Urbain, "L'Exposition de l'Amicale- Impressions personnelles et réflexions des autres", Bulletin de l'Amicale, no. 5, June 1924, p. 4. (Cited in Bois, Troy [see note 56], p. 56.)

68 Urbain (see note 67), p. 4: "Cette manière de travailler permet seule de donner à une construction une beauté plastique que la représentation plane est impuissante à créer, même au moyen de rendus papillonants..."

69 Mallet-Stevens (see note 66): "En 1925, l'Exposition internationale d'Art décoratif moderne doit faire connaître au monde entier ce qu'est l'architecture moderne. Le public se doute à peine qu'il existe une architecture moderne; (...) il demande à être mis au courant des recherches des architectes, à être initié aux formes nouvelles des constructions."

Most observers were struck by the formal unity of the projects exhibited, and by the omnipresence of reinforced concrete. For the reviewer of Art et Décoration, reinforced concrete reigned supreme: "The exhibition's main attraction consists of the works of Mallet-Stevens' students. They do not admit any material other than reinforced concrete."[70] Gustave Kahn, the art critic of the Mercure de France, agreed: "Almost all plan to use recent materials like cement and concrete for the execution of their works."[71] Jacques Mesnil of L'Humanité also perceived reinforced concrete as the common denominator of the projects.[72] In a review of the exhibition in L'Esprit Nouveau, Le Corbusier wrote: "Here we have only buildings to be realized in reinforced concrete...", confirming the current interpretation of art and architecture critics.[73] The exhibition consolidated the perception of reinforced concrete as the universal material of the "new architecture", but as in previous exhibitions, this was a perception based primarily on the reading of architectural models, not built projects.

The properties of reinforced-concrete construction came also to be identified with basic formal traits. In his review of the projects, the critic Mesnil remarked that the exploitation of the building system was mostly visible in the development of horizontal configurations. "The new effects caused by the use of reinforced concrete tend to appear only in the long spans and horizontal tensions, the system permiting a geat reduction in the number of supports, even leaving long horizontal elements unsupported". Mesnil added that "the Dutch of the De Stijl group tend to abuse this effect."[74] Mesnil did not fail

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70 [Anonymous], "Chronique [revue de l'Exposition à l'Ecole spéciale d'architecture]", Art et Décoration, vol. 45, April 1924: "Le principal attrait de l'exposition réside dans les travaux des élèves de Mallet-Stevens. Ils n'admettent d'autres matériaux que le ciment armé."

71 Gustave Kahn, "Art", Mercure de France, vol. 171, 15 April 1924, p. 505: "Presque tous, ils envisagent comme matière d'exécution les dernières nouveautés, ciment et béton".

72 Jacques Mesnil, "Une exposition d'architecture", L'Humanité, 13 April 1924. (Cited in Bois, Troy [see note 56], p. 87.)

73 Le Corbusier, "L'Exposition à l'Ecole Spéciale d'Architecture", L'Esprit Nouveau, no. 23, May 1924, n.p.: "Il s'agit exclusivement ici de constructions à réaliser en béton armé..."

74 Mesnil (see note 72): "Les effets nouveaux dûs à l'usage du béton armé n'apparaissent guère ici que dans la portée et la tension des horizontales, le béton armé permettant de diminuer considérablement le nombre des soutiens ou même de laisser sans soutien des pièces horizontales d'une longueur exceptionnelle. Les Hollandais du groupe De Styl.... ont tendance à abuser de cet effet."

to credit the influence of Le Corbusier for the current predominance of the straight line.[75] Together with Ozenfant, Le Corbusier had lengthily discussed his ideas on the "right angle" a few months earlier in L'Esprit Nouveau.[76] For both protagonists, the idea of orthogonality, of the right angle, was an artistic principle rooted in their conception of human creation and symbolic perfection.[77] It is this idea of orthogonality that Le Corbusier transposed in his analysis of the Ecole Spéciale exhibition. Commenting on the students' projects, he wrote: "It is in this case buildings to be realized exclusively in reinforced concrete, and the forms conceived therefore proceed from the straight line, the right angle, the vertical, the horizontal; this art is eminently orthogonal".[78] For Le Corbusier, the exploitation of the new material announced the advent of an "orthogonal style".

Le Corbusier's forceful equation between reinforced concrete and an orthogonal style suggests a reigning ambiguity regarding the relation between materials and forms. In Le Corbusier's article on the "straight line", orthogonality is praised as a key artistic principle, independent of any technical determination. But in his review of the Ecole Spéciale exhibition, it is the technical development that appears as the primary reason for the genesis of orthogonal forms. As such, the association of reinforced concrete with orthogonal style was merely rhetorical, not structural. For Le Corbusier, the discourse on new materials was subservient to the aesthetic argument.

Cubism and the new architecture

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[75] Mesnil wrote: "...une nouvelle direction apparaît ici comme nettement prédominante en architecture: selon les désirs de Jeanneret-Le Corbusier, l'angle droit règne, l'angle aigu ose à peine se hasarder, toute courbe semble bannie". Mesnil (see note 72). (Cited in Bois, Troy [see note 56], p. 56.)

[76] Le Corbusier, Amédée Ozenfant, "L'angle droit", L'Esprit Nouveau, no. 18, November 1923, n.p.

[77] Le Corbusier (see note 76): "L'horizontale et la verticale déterminent deux angles droits; parmi l'infinité des angles possibles, l'angle droit est l'angle type; l'angle droit est un des symboles de la perfection. En fait, l'homme travaille sur l'angle droit."

[78] Le Corbusier (see note 73): "Il s'agit exclusivement ici de constructions à réaliser en béton armé; on conçoit donc des formes procédant de la droite, de l'angle droit, de la verticale, de l'horizontale, art éminemment orthogonal".

It is also in the context of the 1924 Ecole Spéciale exhibition that the "new architecture" came to be associated with Cubism. The discussion of Cubism by architects was not in itself a new phenomenon. As early as 1918, Le Corbusier, with Ozenfant, had published a theoretical critique of Cubist painting.[79] This critique was not limited to painting, however, extending its reach to other aspects of contemporary life. Writing about modern architecture in 1922, Henri Sauvage declared: "Cubism has not been an art form but a surgical operation" that gave direction to artistic practices as a whole.[80] Yet it is the 1924 exhibition at the Ecole Spéciale that bore witness to the direct and widespread association of the "new architecture" with Cubism. This convergence was due no doubt to the fact that most reviewers were art critics, their reading of architecture being naturally influenced by current paradigms of artistic criticism.[81] This association with Cubism was to strengthen the perception of the new architecture as a formal practice.

Christopher Green has clearly shown that the definition of post-war French art was framed by the debate on Cubism, indeed long after the period of analytic Cubism associated with Picasso and Braque was over.[82] For Green, the Cubism that unfolded between 1914 and 1928 must be understood "not as a heroic line of development isolated and inviolate, but as a set of attitudes and styles tied into a complex fabric of interwoven tendencies, a wide range of opposed alternatives which was often known altogether as l'*art vivant*."[83] With the call for the "retour à l'ordre" of French art after the war, the goal was to reintegrate Cubism within the French tradition. During this phase, Cubism was definitely stripped of its critical dimension. For many critics, all current artistic production came to be evaluated in light of Cubism, among them the decorative arts.

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[79] See Ch.-E. Jeanneret, Amédée Ozenfant, Après le cubisme, Paris, Ed. des Commentaires, 1918.

[80] Sauvage (see note 21), p. 334: "Le cubisme ne fut pas une forme d'art mais bien un opération chirurgicale." He added: "Pardonnons donc au cubisme ses erreurs. Nous lui devons de nous avoir fait réfléchir, et par son excès même de nous avoir ramenés aux vérités premières."

[81] Among the many art critics which made the connection with Cubism were Louis Vauxcelles, Waldemar George, Yvanhoé Rambosson, Jacques Mesnil and Gustave Kahn.

[82] Christopher Green, Cubism and Its Enemies, New Haven, Yale University Press, 1987.

[83] Green (see note 82), p. 139.

"Between 1918 and 1928", Green writes, "there was no denying the extensive influence of Cubism on the decorative arts in France; it was a frequently observed fact", adding: "several commentators believed that this [influence] was Cubism's most significant effect".[84] In his review of the furniture presented at the Ecole Spéciale exhibition, the art critic Waldemar George gives the most potent illustration of Green's assessment.[85] For George, the use of geometric ornaments by decorative artists like Pierre Chareau and Eileen Gray was a proof of the widespread dissemination and vitality of Cubist art.[86]

By 1924, Cubism was also credited with having had an important impact on architecture, an impact commonly identified with the predominance of geometry and the "straight line". Discussing the works exhibited at the Ecole Spéciale exhibition, Gustave Kahn wrote in Mercure de France: "Among recent exhibitions (or the ones organized by the cubists) the one where Cubism is most prominent. One must conclude that architects find some qualities in this aesthetic and attribute it, not without reason, a decorative value."[87] Quite unexpectedly, the enemies of Cubist painting interpreted the reappearance of Cubism in architecture as a positive occurrence. The argument developed by Louis Vauxcelles, the most famous adversary of Cubism, is revealing: "It was normal that cubism, having been 'eliminated' by the painters, found refuge with architects. This geometry is more at home there than in a painting. It is less surprising to see a train station or a bank resembling a cube than the portrait of a young girl."[88] Vauxcelles

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84 Green (see note 82), p. 222.

85 According to Green, Waldemar George was a pro-cubist critic who saw the future of modern painting in "the possible bringing together of the constructive lesson of Cézanne and the colouristic lesson especially of Renoir." Green (see note 82), p. 84.

86 Waldemar George, "Exposition d'Architecture et d'Art décoratif", Paris-Journal, 11 April 1924.

87 Gustave Kahn (see note 71), p. 505: "C'est d'ailleurs parmi les expositions récentes, ou organisées par des cubistes, celle [l'exposition à l'Ecole spéciale d'architecture] où le cubisme tient le plus de place. Il en faut conclure que les architectes trouvent des qualités à cette esthétique et lui attribuent, sans doute avec raison, une valeur décorative."

88 Louis Vauxcelles, "La Semaine Artistique", L'Ere nouvelle, 27 March 1924: "Il était normal que le cubisme à peu près 'éliminé' par les peintres, se réfugiât chez les architectes. Cette géométrie est mieux à sa place là que dans un tableau. On s'étonnera moins de voir une gare ou une banque ressemblant à un cube qu'un portrait de jeune fille. Mais tout de même une rue uniquement meublée de cubes, ce n'est pas gai."

believed that cubism in architecture was normal, while in painting it was irritating.[89] This argument was shared by Jacques Mesnil, who believed that, contrary to painting, Cubism in architecture could claim a kind of internal logic.[90] Both critics seemed relieved to observe the migration of Cubism from painting to architecture, viewed as its more natural setting.

The presumed influence of Cubism on architecture was not always welcome. For Yvanhoé Rambosson, most of the projects adopted the forms of a *cubisme intégral*, an unfortunate predominance of the vertical and the horizontal at the expense of the curve, an excess that brought with it a loss of sensibility.[91] The notion of *cubisme intégral* was taken up by other reviewers, among them Louis Hautecoeur -- art historian and editor of L'Architecture. In a critical review of Vers une architecture, Hautecoeur wrote about the new architecture proposed by Le Corbusier: "This *cubisme intégral*, this implacable geometry, this aesthetic Calvinism... may be necessary to attract attention, but soon becomes extremely monotonous."[92]

With Cubism interpreted as both a decorative and an architectural practice based on geometry, the "new architecture" was quickly assimilated to three-dimensional variations based on the cube.[93] This limited and limiting conception of the rapport between Cubism and architecture was clearly spelled out in the pages of the Bulletin de la Vie Artistique. In

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89 Louis Vauxcelles, "La vie artistique", L'Eclair, 2 March 1924. (Cited in Bois, Troy [see note 56], p. 87.)

90 Mesnil wrote: "Inutile de dire qu'en peinture le 'cubisme' paraît beaucoup moins justifié qu'en architecture, où il peut se réclamer d'une logique interne." Mesnil (see note 72). (Cited in Bois, Troy [see note 56].)

91 Rambosson wrote: "La tendance est donc ultra-moderne et c'est bien. Où je trouve à redire, c'est à l'adoption à peu près générale des formes de construction du cubisme intégral, celui qui ne procède que par verticales et horizontales, en dédaignant la courbe." Yvanhoé Rambosson, "Une exposition d'architecture", Comoedia, 30 March 1924.

92 Louis Hautecoeur, "Trois théories de l'architecture", L'Architecture, vol. 37, no. 7, 10 April 1924, p. 80: "Ce cubisme intégral, cette implacable géométrie, ce calvinisme esthétique (qu'on ne voit en ce mot aucun sens péjoratif) peuvent être nécessaires pour attirer l'attention, mais offriraient bientôt une monotonie accablante."

93 In contrast with the formal position of French critics, Sigfried Giedion understood the relation of Cubism to modern architecture as the interpenetration of inside and outside, and the development of the fourth dimension. See S. Giedion, Space, Time and Architecture: The Growth of a New Tradition, Cambridge, Harvard Univ. Press, 1941.

a series of articles titled "At home with the cubists", Guillaume Janneau investigated a position defended by a several architects and reinforced by Mallet-Stevens.[94] From the outset, Mallet-Stevens posited the cube as the basic compositional element of architecture.[95] To design a house was to sculpt an enormous block. And, going beyond the single compact block, the modern architect was to manipulate a series of monolithic cubes.[96]

On the reinforced-concrete cube

For Mallet-Stevens, this proliferation of monolithic cubes was wholly indebted to the exploitation of the most modern material. "In our day", Mallet-Stevens stated, "reinforced concrete completely transforms the problems that the builder has to solve. Thousands of forms are possible and unexpected silhouettes are created, at times strange but still rational and sincere. Reinforced concrete allows cantilevers, the elimination of numerous points of support, and the reduction to a minimum of the various building elements. Proportions are thus deeply modified; the aesthetic is no longer the same."[97] An ambiguity attaches to Mallet-Stevens' allusion to monolithic cubes made with the help of reinforced concrete, however, for his evocation of monolithism recalls the interpretations of Auguste Choisy. In his analysis of Roman construction, Choisy assimilated the monolithic quality of agglomerate construction with a homogeneous entity, a solid mass.[98] This idea of a homogeneous mass contrasted with the contemporary

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94 Mallet-Stevens in G. Janneau, "Chez les cubistes, Notre enquête - III. Réponse de Mallet-Stevens", Bulletin de la Vie Artistique, no. 23, 1 Decembre 1924, pp. 532-534.

95 Mallet-Stevens stated: "Une maison, un palais sont composés d'un ensemble de cubes. A toute les époques de l'art la maison a été cubique". Mallet-Stevens (see note 94).

96 Mallet-Stevens stated: "L'architecte moderne peut faire autre chose qu'un bloc compact fait de pierre, de bois, de fer... ; il peut 'jouer' avec une succession de cubes monolithes". Mallet-Stevens (see note 94).

97 Mallet-Stevens (see note 94), p. 533: "De nos jours, le béton armé transforme complètement les problèmes qu'a à résoudre le constructeur. Milles formes sont permises, des silhouettes imprévues surgissent, étranges parfois mais rationnelles, sincères. Le béton armé permet les porte-à-faux, la suppression de nombreux points d'appui, et la réduction au minimum des différents éléments de construction. Les proportions se trouvent alors profondément modifiées, l'esthétique n'est plus la même."

98 Choisy wrote: "Le corps des édifices se réduit à un massif de cailloux et de mortier, un monolithe construit, une sorte de rocher artificiel." Auguste Choisy, Histoire de l'architecture, tome 1, Paris, Gauthier-Villars, 1899 [1991], p. 512.

interpretation of monolithism as a quality embodied in the reinforced-concrete frame.[99] For Mallet-Stevens, the quality of monolithism seemed to belong to the homogeneity of the form, not the structural quality of the frame.

Starting with the cube as the primary compositional element, the potential offered by modern materials was the possibility of developing a number of new and unexpected forms. Insisting on the originality of forms and changes in proportion, Mallet-Stevens' discourse recalled the arguments developed before the war by reinforced-concrete engineers and specialized builders. Evoking the notions of rationality and sincerity, he reiterated turn-of-the-century arguments sustained by Anatole de Baudot and the Rationalist school. But with Mallet-Stevens, the connection between modern materials and architecture was primarily conceived in terms of formal mutations, not in terms of rational construction.

In the aftermath of the 1924 Ecole Spéciale exhibition, the assimilation of the modern house with the reinforced-concrete cube became almost commonplace. Commenting on André Lurçat's project for a double house exhibited at the Salon des Artistes décorateurs in the Summer of 1924, the critic of L'Architecture simply wrote: "The 'style' of the construction is that of the cubic house in cement".[100] In L'Architecture Vivante, Jean Badovici also associated the new architecture with cubic shapes. In an article devoted to the recently completed hangars at Orly, Badovici noted that in reinforced-concrete constructions cubic forms were usually dominant, making a veiled allusion to the current proliferation of projects based on the cube. Badovici was puzzled by the dominance of the straight line, since projects like the Orly hangars offered a vivid demonstration of the curved shapes that could be achieved. This dominance of straight lines was all the more surprising for him given that the material used was so flexible that

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99 A conception largely indebted to and promoted by François Hennebique, and defended by Auguste Perret.
100 Gabriel Veissière, "Le Salon des artistes décorateurs", L'Architecture, vol. 37, no. 13, 10 July 1924, p. 163: "Le 'style' de la construction est celui des maisons cubiques en ciment".

it could be submitted to the will of the architect.[101] In his advocacy of the curve, Badovici was at odds with the trend that dominated the new architecture. He was indeed critical of the Ecole Spéciale exhibition, saying that the student projects tended to follow a system that had become an intangible dogma.[102] But while opposing the curve to the straight line, Badovici at the same time reiterated the current interpretation of reinforced-concrete construction in terms of basic formal configurations.

Dutch architecture as precedent

The stylistic character of the new architecture -- variations based on unadorned cubic shapes -- was further reinforced through its comparison with contemporary Dutch architecture. By 1924, many architecture critics explained the new French architecture by the precedent of the Dutch model. This interest in the new Dutch architecture can be securely attributed to the two De Stijl exhibitions presented, in quick succession, in the fall of 1923 and the spring of 1924. Interest in Dutch architectural theory and criticism was not lacking. In November 1923, Hendrik Petrus Berlage gave a lecture at the Sorbonne that was reviewed by Jean Badovici in the second issue of L'Architecture Vivante.[103] Indebted to the teaching of Cuypers and Viollet-le-Duc, Berlage insisted on the eternal value of the "constructional organism". Yet this Rationalist position was quickly counteracted by that of the new generation. In the spring of 1924, the Bulletin de l'Effort Moderne published a long article by J.J.P. Oud entitled "Tomorrow's architecture and its Architectonic possibilities".[104] Excerpts from this article were also published by Badovici in the summer 1924 issue of L'Architecture Vivante.[105] A passage

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[101] Jean Badovici, "Entretiens sur l'architecture vivante", L'Architecture Vivante, vol. 2, Spring 1924, p. 19.

[102] Badovici "Entretiens sur l'architecture vivante", L'Architecture Vivante, vol. 2, Summer 1924, p. 33: "on dirait enfin que l'observation d'une certaine formule imposée soit considérée comme un dogme intangible."

[103] Jean Badovici, "En Hollande. H.P. Berlage", L'Architecture Vivante, vol. 1, Winter 1923, pp. 21-25.

[104] J.J.P. Oud, "Les possibilités architectoniques de demain", Bulletin de l'Effort Moderne, no. 4, April 1924, pp. 1-5; no. 5, May 1924, pp. 9-13; no. 6, June 1924, pp. 13-15.

[105] Badovici (see note 102), vol. 2, pp. 29-32.

on the possibilities offered by concrete construction reveals Oud's lack of interest in the expression of the structural frame: "[Only concrete] permits lines that are sharp and precise, surfaces that are perfectly homogeneous, the extension of horizontal masses."[106] While recognizing the impact of material factors, Oud believed in the possibility of freeing architecture from its visible weightiness and revolutionizing architectural expressions.

By then, Oud was no longer a member of De Stijl. His theoretical position differed notably from that sustained by van Doesburg in the De Stijl manifesto, "Vers une construction collective", distributed during the spring 1924 Ecole spéciale exhibition.[107] Yet his works were included in the De Stijl group exhibition, blurring the distinction between the two approaches. The presence of his work did much to give a tangible character to the new Dutch architecture. Promoted by L'Architecture Vivante, Oud's work rapidly became the main reference of Dutch modernism in France (fig.71).[108] Despite the diffusion of Oud's and van Doesburg's theoretical positions, it is the image of Dutch works that had the most direct impact. French architecture critics focused on the formal aspect of the works, not on their theories, and it is these formal qualities that were considered to have influenced French architecture. "In the study of those constructions based on rectangular forms devoid of decorations", Veissière wrote in the summer of 1924, "the French have not equalled the virtuosity of the Dutch, who are masters of the genre."[109]

The precedent set by Dutch architects was duly noted and analyzed by the editor of L'Architecture. Reviewing the 1924 Salon d'Automne, Hautecoeur recognized the

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106 Badovici (see note 102), p. 32: "lui seul permet les lignes nettes et précises, les surfaces parfaitement homogènes, l'extension des masses horizontales".

107 On the publication of the De Stijl manifesto, see Bois, Troy (see note 56), p. 50.

108 During the year 1924, Badovici published as many as 11 plates of Oud's work in the pages of L'Architecture Vivante.

109 Veissière (see note 100), p. 163: "Dans l'étude de ces constructions aux formes rectangulaires dénuées de toutes décorations, les Français sont encore loin d'égaler la virtuosité des Hollandais qui s'affirment maîtres du genre."

dominance of the aesthetic proposed by Le Corbusier.[110] But the repetition of these "concrete cubes", of these "windows that are wider than they are tall", of these "terraced roofs", led Hautecoeur to underscore the priority of the works of Oud and the De Stijl group as compared with those of French architects. Going further with this comparison, Hautecoeur expressed concern over the way French architects were transposing brick architecture into reinforced concrete. Assimilating Dutch architecture with the tradition of buiding in brick, Hautecoeur argued that the simplicity of the forms achieved was due to brick construction.[111] That the new Dutch architecture exploited the possibilities of that mode was confirmed by the three executed projects presented at the two De Stijl exhibitions. The two executed projects by Oud, Spangen and Tusschendijken in Rotterdam (1918-22), plus that by Wils, the "Daal-en-Berg" complex in The Hague (1919-22), were all built in brick. For Hautecoeur, the formal and constructional precedent set by Dutch architecture was somehow misapplied by French architects, who translated it into concrete, and thus reduced it to an aesthetic model.

But the material basis of the new Dutch architecture remained ambiguous. Some of Oud's unexecuted projects presented smooth and unadorned cubic shapes, rejecting the signs -- texture and color -- of traditional brick construction. In France, smooth wall surfaces came naturally to be associated with reinforced-concrete construction, an association reinforced by the critical reception of the Schröder-Schrader house built in Utrecht in 1924. It is with the Schröder-Schrader house, designed by Gerrit Rietveld in collaboration with Ms. Schröder, that the plastic principles of De Stijl were materialized for the first time. Presenting the house in L'Architecture Vivante, Badovici did not hesitate to write that it was built of iron, reinforced concrete, and glass.[112] Although, like

110 Louis Hautecoeur, "Le Salon d'Automne", Gazette des Beaux-Arts, vol. 66, 5th period, tome 10, December 1924, p. 348.

111 Hautecoeur wrote: "On comprend cette architecture en un pays où la construction est une construction de briques: c'est-à-dire une construction concrète, dont les formes sont nécessairement des formes simples. Ce sont ces mêmes formes que les matériaux imposèrent il y a des milliers d'années aux architectes égyptiens ou mésopotamiens." Hautecoeur (see note 110), p. 349.

112 Badovici, "Entretiens sur l'Architecture vivante", L'Architecture vivante, vol. 3, Winter 1925, pp. 28-29.

many other Dutch projects, it was actually constructed in brick masonry with metal beams and coated with white plasterwork.

Conclusion

On the eve of the 1925 Decorative Arts exhibition, most observers of the architectural scene in France had acknowledged the birth of a new aesthetic based on undecorated cubic forms and the exploitation of reinforced-concrete construction. Perceived indiscriminately as an artistic *matière* and a building *material*, reinforced concrete did not have a clearly defined technical status. Moreover, the critical assessment of its impact was generally based on a reading of architectural models, not executed buildings. As such, the association between material and aesthetic remained grounded in ideological constructs, not building practices.

In the January 1925 issue of L'Esprit Nouveau, Le Corbusier commented on the potential impact of reinforced concrete on this new architecture.[113] He claimed that while the building system could be used to "make things hold" it was a more difficult matter to achieve with it a "higher level of synthesis", by which Le Corbusier meant the simultaneous and perfect organization of both the structural and the plastic systems.[114] Claiming that architects were not quite clear about what plastic system was to derive from the constructional system, he added: "The study of the plastic system of reinforced concrete leads us to the present moment."[115] Contrary to most observers of the architectural scene, Le Corbusier believed that the plastic system of reinforced-concrete construction had yet to be found, and was still in the making. The search for it was to be conducted through the conception and construction of the modern house.

2. Reinforced concrete and the Construction of the Modern House (1924-1927)

113 Le Corbusier, "L'heure de l'architecture", L'Esprit Nouveau, no. 28, January 1925, pp. 2386-2391.
114 I translate Le Corbusier's difficult expression *faire faire la sphère* as "higher level of synthesis".
115 Le Corbusier (see note 113), p. 2389: "Cette recherche d'un système plastique du ciment armé nous conduit à l'heure présente."

By the end of 1924, the form and character of the new architectural aesthetic was broadly defined, but the exact nature of its technical configuration remained vague. Reinforced concrete evoked ideas of modernization and modern construction, but the expression itself said little about the various attitudes and practices associated with the use of this building system. The display of theoretical projects and models proved a fertile ground for the broad definition of the new aesthetic, but it was the actual construction of modern houses that clarified -- or concealed, as the case may be -- the relation between modern materials and the new aesthetic. Beyond the merely rhetorical advocacy of reinforced concrete, the realization of these houses was to highlight the different conventions, constraints, and innovations at play in the use of the new material.

On the construction of the modern house

In a recent study on the French modern movement, Gilles Ragot examined the development of the modern house during the 1920s and 1930s in Paris and the Ile-de-France area.[116] Paying special attention to the question of materials and construction methods for both executed and unexecuted projects, the study provides useful information on the degree to which reinforced concrete was used in the production of modern houses.[117] From the outset, the author distinguishes between horizontal (floor and roof) and vertical (framework) structures. While most projects employed reinforced concrete for horizontal structures, only 34 percent made use of reinforced concrete for both vertical and horizontal structures.[118] Clearly by the 1920s the use of reinforced-

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116 Gilles Ragot, "Le mouvement moderne 1922-1933. Exigences et compromis", 3 vols., doctoral dissertation, Paris, Paris IV-Sorbonne, October 1993.

117 Ragot's study is based on a corpus of more than 300 modern houses conceived between 1920 and 1939. The data collected provided some information on the construction system employed for 180 cases. While the figures proposed must be relativized due to the variability of the information available, they are nonetheless indicative of certain trends.

118 Ragot (see note 116), vol. 1, p. 194.

concrete floors had become general practice. At the same time, only 4 percent of the houses executed used steel frame construction.

A large proportion of the houses built were based on the combination of two structural systems, a mixed system usually combining one or more load-bearing walls and a network of posts and beams in reinforced concrete. According to Ragot, the decision to use a mixed system was largely influenced by the building site. In an urban context, traditional party walls could be used as load-bearing structures. In the case of a narrow lot, the reinforced-concrete beams or floor slabs could span the entire distance between the party walls. In the case of wider lots, a middle support -- either a supporting wall or a combination of posts -- was necessary. As the study reveals, 50 percent of the houses erected in an urban context made use of a mixed structural system, while only 20 percent were entirely based on load-bearing masonry construction.[119] In light of these figures, Ragot adds that when architects were faced with the choice between load-bearing walls or posts for internal supports, 80 percent of the projects made use of structural posts when the urban context prevented the implementation of an entire skeleton. For Ragot, these figures indicate the broad adoption of the "principle" of skeleton construction for the single house.[120] According to the author, the preference for a frame over load-bearing walls is further revealed in a comparative study of projects and realizations. While 50 percent of the projects were conceived on the basis of skeleton construction, only 38 percent of the executed projects were so conceived. Site, client, and execution constraints thus appear to have limited the implementation of frame construction.

Ragot's investigation is based on the assumption that the modernity of reinforced-concrete construction is embedded in the autonomous structural frame. In his study, the

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119 Ragot (see note 116), vol. 1, p. 195.

120 Ragot writes: "(...) le recours à une solution mixte -- murs mitoyens/poteaux -- dans cinquante pour cent des cas, en milieu urbain, nous semble le signe d'une pénétration considérable du principe de l'ossature dans le programme pourtant modeste de la maison individuelle." Ragot (see note 116), vol. 1, p. 195.

construction of the modern house is understood to have been an alternative between masonry and reinforced-concrete construction. Reinforced concrete is studied only in connection with frame construction, ignoring other building techniques like mass concrete and moulded concrete with shutters (*béton banché*). The extensive use of a mixed structural system and the limited use of reinforced-concrete vertical supports Ragot interprets as an embryonic system leading to the full fledged skeleton. There are problematic assumptions here, as in the distinction between a partial and a full frame treated as a question of quantity not quality. As such, Ragot does not take into account diverging conceptions of skeleton construction and their potential role in the design process. To grasp more fully the place of reinforced concrete within the French modern movement, it is necessary to examine its role in the construction of modern houses.

Perret and the construction of the maison Gaut (1922-23)

One of the first houses to embody the idea of modern materials and techniques in domestic architecture in the early 1920s was the maison Gaut, Paris (1922-23), by Auguste Perret. Originally assigned to Le Corbusier, the commission for the maison Gaut was finally granted to Perret, a change that was to accelerate the rupture between the two.[121] In a letter to Perret, Le Corbusier criticized the plastic quality of the building, a fact that involved the maison Gaut in the current definition of the new aesthetic.[122] That the maison Gaut was a valuable contribution is further confirmed by the fact that images of the house illustrated Theo van Doesburg's first article on French modern architecture in the Dutch journal Het Bouwbedrijf (fig.72).[123]

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121 Fanelli, Gargiani (see note 42), pp. 137 ff.

122 Le Corbusier wrote: "(...) vous finissez Gaut maintenant et c'est avec cette maison que vous prétendez établir les règles définitives de l'architecture moderne tant esthétique que constructives ; vraiment, vous vous aveuglez un peu trop ; permettez que d'autres pensent différemment et que si on vous accorde d'être un parfait ingénieur, on est moins certain quant à vos dons de plasticien." Le Corbusier, letter to Auguste Perret, 13 December 1923 (Fonds Perret, 535 AP 318).

123 Theo van Doesburg, "Persisting Life-Style and Architectural Innovation" (Het Bouwbedrijf, vol. 1, no. 4, October 1924), in Theo van Doesburg, On European Architecture, Basel-Berlin-Boston, Birkhäuser Verlag, 1990, pp. 15-23.

In the execution of the house Perret adopted a building technique that combined masonry and reinforced-concrete construction.[124] The floor slabs in reinforced concrete were carried by load-bearing masonry walls. While the wall on the lot line was a party wall based on traditional stone masonry, the three remaining walls were made of brick and mortar. Every ten layers of brick, a cement joint reinforced with two wires formed a belt that encircled the house. The brick masonry wall was also made of a double layer: bricks 11 cm thick on the outside, plaster panels 5 cm thick on the inside, with a space of 4 cm between. The floor slabs were of concrete reinforced with a metal armature, and were given additional support by transverse beams in reinforced concrete (fig.73). The floor slabs was entirely crafted in place: concrete was poured over the armature in formworks held in place with struts. A large circular opening on the first floor that created a double height-space required the calculation and design of a special reinforcement, the complexity of which was further increased by the opening of the staircase and the asymmetry of the house plan. The transverse beams that strengthened the slabs generally accorded with the partitions of the plan, and the floor slabs also served as lintels for some of the window openings of the house. The slab of the roof terrace was made with structural beams in reinforced concrete, transverse joists in clinker concrete, and an infill of hollow plaster blocks. This structure was further covered with a triple layer made of concrete blocks (*forme en béton*), tar paper (*ciment volcanique*), and a cement coating. The vase-shaped cornice was also in reinforced concrete (fig.74). Because of its external shape and internal armature, the crafting and casting of the cornice required high execution skills.[125] The external brick walls were covered by a uniform coating -- called *lithogène* -- based on alabaster plaster and stone powder. This re-surfacing of the external wall concealed the heterogeneous quality of the brick wall, unifying the vertical and horizontal elements.

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[124] For a description of the house, see Jean Badovici, "Petit Hôtel particulier, à Paris, rue Nansouty, par A. et G. Perret", L'Architecture Vivante, vol. 2, Spring 1924, pp. 14-16, pl. 1-13.

[125] Badovici wrote: "La corniche, également en béton armé, *ravalée* au lithogène, en forme de vase; double but: protection et recherche esthétique". Badovici (see note 124), p. 16.

The building technique adopted for the maison Gaut must be examined in light of Perret's conception of domestic architecture in the post-war period. Perret's only published project of domestic architecture was presented in the December 1921 issue of L'Esprit Nouveau.[126] According to the caption, the house was to have a cavity wall made with the cement gun technique. This double wall was to be made of sprayed cement on a metal latticework on the outside and of plaster on the inside. Neither the drawings nor the captions are clear about the structural system advocated, for while two rounded posts appear on the facade, the rest of the structure is not clearly described. But the overall aesthetic of the house is clearly marked by the conspicuous cornice and the homogeneous appearance of the walls.

Perret's first documented experience of house construction after the war was in the construction of a double house at Grand-Quévilly near Rouen, which according to an unpublished description written a few years later was in reinforced concrete with brick infill.[127] But as the available drawings seem to indicate, the structure of the house was based on load-bearing brick walls on three sides, complemented with reinforced-concrete pillars on the facade (fig.75).[128] The load-bearing walls were further strengthened with pillars apparently made of brick. The overall thickness of the double-layered brick wall was 22 cm. Reinforced-concrete slabs spanning the entire width of the house constituted the floors and roof, the latter being endowed with a special edge that formed the roof cornice. Finally, the external brick walls were covered by a cement coating (*mortier de chaux*) that emphasized the unified character of the construction.

Likewise combining reinforced concrete with brick construction, the maison Gaut stood in continuity with this Rouen building. For the reviewer of L'Architecture Vivante,

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[126] Le Corbusier-Saugnier, "Maisons en série", L'Esprit Nouveau, no. 13, December 1921, pp. 1526-1527.

[127] Marcel Mayer, "Auguste Perret. L'homme, l'oeuvre, le novateur", unpublished typed manuscript [c. 1926], p. 141 (Fonds Perret, 535 AP 358).

[128] The drawings preserved at IFA document two projects, dated 29 July 1922 and 18 August 1922. Maison de contremaître à Grand-Quévilly (Fonds Perret, 535 AP 17/2). See L'Architecture Vivante, vol. 3, Summer 1925, pl. 33-37; also: A. Goissaud, "Notes sur l'oeuvre des architectes A.-G. Perret. Maison de contremaître à Grand-Quevilly", in La Construction moderne, vol. 41, no. 44, 1926, pp. 521-524.

the maison Gaut was modern because of its technical and aesthetic aspect. The Perrets, Badovici argued, had built a *maison type* because the materials employed were the ones that best suited the needs of modern technique: "Reinforced concrete is essentially modern and of universal value, not only because of the economy it allows, but also because of its flexibility, the freedom it gives, and the prospects it offers to architectural invention."[129] For Badovici, this project testified to the development of an "art of reinforced concrete".[130]

Yet in the maison Gaut, reinforced concrete was mostly used for the making of the horizontal part of floors and roof terrace, not for the vertical parts, the structural skeleton. As noted by Ragot, this restricted use of reinforced concrete was almost the norm. Since the turn of the century, various systems of reinforced-concrete floors were commonly employed in residential buildings as an alternative to floor systems based on metal beams and terracotta blocks. As a cursory exploration of the Hennebique archive makes clear, the construction of reinforced-concrete floors constituted a large number of the projects handled by the firm --floors commonly used in combination with traditional heavy-masonry construction. In the maison Gaut, the heavy-masonry walls were replaced by a lighter wall system based on load-bearing bricks 11 cm thick. As Perret later explained, he advocated the cavity wall because he did not believe in the thermal quality of walls made of single hollow blocks.[131] The technique of reinforced concrete was thus exploited as a complement to a building process largely indebted to the logic of modern masonry construction. Here the technical modernity of the house relied on a rational

[129] Badovici (see note 124), p. 16: "Le béton armé est essentiellement moderne et de valeur universelle, en effet, non seulement à cause de l'économie qu'il permet de réaliser, mais encore à cause de sa souplesse, des libertés qu'il permet et des horizons qu'il ouvre à l'invention architecturale."

[130] Badovici wrote: "Ils [Perret] montrent qu'il y a un art du béton armé, que cet art est capable d'exprimer l'époque, ses préoccupations et ses besoins." Badovici (see note 124), p. 16.

[131] Describing the maison Mouron in Versailles (1924-25), Perret wrote: "Tous les murs extérieurs sont à double paroi, ils ne sont pas composés de ces blocs creux dont les petits vides ne produisent qu'une isolation illusoire, mais bien d'une paroi extérieure en brique et d'une paroi intérieure en carreaux de plâtre, avec entre les deux un vide de 3 à 4 centimètres qui s'étend sur toute la hauteur de chaque étage." Maison Mouron (Fonds Perret, 535 AP 329).

marriage between, not the separation of, the technique of modern masonry and reinforced-concrete construction.

Le Corbusier and the construction of the villa Besnus (1923)

Perret's conception can be compared to Le Corbusier's contemporary construction of the villa Besnus at Versailles (1923).[132] Contrary to the maison Gaut, the villa Besnus was to be built on a suburban site and with a reinforced-concrete frame (fig.76). The contract signed between the client and the general contractor G. Summer ("Ingénieur Constructeur Entreprise générale") specified the nature of the construction: "The general skeleton of the construction is constituted by a reinforced-concrete plan and floors in hollow cement blocks carried by reinforced-concrete beams".[133] The wall infill was to be made of brick, with a double-layer system similar to the one employed by Perret: terracotta bricks 11 cm thick on the outside, plaster panels 5 cm thick on the inside, with a space of 7 cm between. The contract's specifications gave very little information about the constitution of the concrete frame itself, noting only that the reinforced-concrete floors were based on a system of joists with hollow cement blocks. An examination of the construction drawings reveals that the four internal posts supported the transversal beams, which supported floor joists spanning the entire width of the house.[134]

Le Corbusier's earlier experience with reinforced-concrete construction in domestic architecture was the execution of the villa Schwob (1916-17) in La Chaux-de-Fonds. Based on a grid of 16 square posts supporting the floor slabs, the structure of the villa was calculated by a Zurich engineering firm and executed by local builders.[135] Exterior

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[132] Perret's maison Gaut could also be compared with Le Corbusier's atelier Ozenfant built on the same street. However, I have not been able to examine the tender by the entrepreneur Pierre Vié (dated 10 April 1923) preserved at the Fondation Le Corbusier. For a chronology of the villa Besnus project, see Tim Benton, The Villas of Le Corbusier 1920-1930, New Haven-London, Yale University Press, 1987, pp. 23-28.

[133] Contract with G. Summer, 23 April 1923 (FLC H1-9-43): "L'ossature générale de la construction sera constituée par un plan de béton armé et planchers en blocs creux de ciment entre solives de béton armé."

[134] H. Allen Brooks (ed.), The Le Corbusier Archive, New York, Garland, vol. 1, p. 418.

[135] See chapter III.

walls made of high-quality bricks provided an envelope for the villa's concrete structure. In the case of the villa Besnus, both the calculation and the execution of the reinforced-concrete structure was done by the contractor -- in fact, the concrete and the masonry work were executed by the same firm. The material continuity between the concrete frame and the brick infill was to be enhanced by an external coating: as the contract specified, both frame and wall were to be covered with a homogeneous coating of *lithogène*, or "any external revetment that could resist freezing and render the quality of stone".[136]

Both the maison Gaut and the villa Besnus exhibited the potential of reinforced-concrete construction. The difference between the two lay in the mode of execution of the concrete elements. In the maison Gaut, reinforced concrete was exploited for the execution of custom-made building elements (floor slabs, cornice, etc.). The fabrication of these elements, which depended on the crafting of special wooden formworks and metal armatures, required considerable skill. By contrast, the reinforced-concrete plan of the villa Besnus mostly relied on structural elements that appear to have required no special attention. The limited specifications in the contract with the contractor tend to indicate that the frame to be built was standardized, and conceived according to standard practice.

Apart from the essential difference of the structural system employed (load-bearing walls vs skeleton construction), both houses made use of a similar light-masonry-wall system made of a double layer of bricks and plaster panels. The cavity wall system had first been implemented in frame construction at the turn of the century.[137] In the early 1920s, the use of brick masonry walls partook of the current modernization of masonry construction. This light masonry wall called for the use of a special coating that sealed and gave uniformity to the porous and heterogeneous wall surfaces, a process that recalled the practice of *ravalement* common in traditional masonry construction.

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136 Contract (see note 133) (FLC H1-9-44): "les enduits extérieurs en lithogènes ou toute autre matière analogue reconstituant la pierre et résistant parfaitement au gel et n'étant pas poreux."
137 See chapter II.

The execution of both houses testified to the changes in current construction methods. While partaking of the modernization of masonry construction they also reveal the current complementarity between masonry work and reinforced-concrete construction. Yet despite the exploitation of reinforced-concrete elements, both the maison Gaut and the villa Besnus evoke solid masses that do not depart from the visual tradition of masonry construction. These two examples show that during the early 1920s the construction of the modern house was indebted to a marriage of reinforced concrete with modern masonry construction. Villa construction in the Paris area peaked between 1925 and 1928, and the most productive architects of the day were Robert Mallet-Stevens, André Lurçat, Le Corbusier and Pierre Jeanneret.[138] An analysis of their work will show this current assimilation of reinforced-concrete construction and its impact on the definition of the new architectural aesthetic.

Mallet-Stevens and the dissociation of construction and aesthetic

During the early 1920s, Mallet-Stevens' discourse on materials encouraged the perception of reinforced concrete as a determinant of the "new architecture". This hastily announced marriage between material and aesthetic concealed the ambiguous relation of technique to the new "cubist" architecture. Mallet-Stevens' project for the villa Noailles, a commission for a villa to be built in the south of France, reveals a discrepancy between discourse and practice. The first phase of the project, begun in June 1923, was devoted to the study of the site; Mallet-Stevens' early studies for the villa itself were done between January and May 1924. A direct output of this study phase was the small-scale model presented in spring 1924 at the Ecole spéciale exhibition.[139] Anonymously titled "villa 1924", the model had apparently been rejected by the client for its overt insistence on formal rather

138 Ragot (see note 116), vol. 1, p. 67.
139 The "villa 1924" model recalled the model for a house at Marnes-la-Coquette illustrated in G. Janneau's article published in the Bulletin de la vie artistique, vol. 4, no. 11, 1 June 1923, p. 231.

than functional issues (fig.77).[140] In its form, the model seemed indifferent to structural and material data, and indeed the villa's early studies show that Mallet-Stevens did not design with a particular construction method in mind.[141]

The issue of construction emerged only after completion of the preliminary project, and was dealt with by the local architect in charge of technical aspects and the building site. According to the architect's estimate, the structure was to be based on conventional materials: the walls were to be made of rough stones found on the site, the floors would be made of small brick vaults resting on metal I-beams, with sills made of bricks and lintels made of small metal I-beams. But the client -- who wished to have a villa built with "modern materials" -- demanded that the plans be sent to a builder specialized in reinforced-concrete construction.[142] The architect proposed a combination of reinforced-concrete floors with mass concrete: "The pillars and floors would be in reinforced concrete, and the thick walls would be in concrete compressed in formworks 0,35 m wide."[143] In the absence of a reply from the specialized firm, the house was finally built by a local contractor with traditional materials and construction methods (fig.78). Despite the resulting thickness of masonry walls (50 cm), Mallet-Stevens did not modify the plans. The only elements in reinforced concrete were the cantilevered slab and the window-breast of the balcony. The rough stone wall was covered with a cement coating that stressed the homogeneity of the facade. The impression of massiveness created by this homogeneous volume was not very different from that generated by the villas in mass concrete built by Tony Garnier near Lyon.[144] Mostly involved in paper architecture projects and stage-set design until 1923, Mallet-Stevens had had little experience with

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140 Cécile Briolle, Agnès Fuzibet, Gérard Monnier, La Villa Noailles de Mallet-Stevens, Marseille, Parenthèses, 1990, p. 19.
141 Briolle et al. (see note 140), pp. 26-27.
142 Briolle et al. (see note 140), p. 26.
143 Briolle et al. (see note 140), p. 27."Les piliers et planchers seraient en béton armé et les gros murs en béton comprimé entre coffrages avec une épaisseur de 0,35 maximum."
144 Pol Abraham, "Groupe de Trois villas à Saint-Rambert l'Ile-Barbe (Rhône)", L'Architecte, vol. 1, no. 1, January 1924, pp. 4-5.

building execution. This episode clearly shows a dissociation in his early practice between constructional and aesthetic programs.

Mallet-Stevens' first compelling involvement with the technique of reinforced-concrete construction was in the conception of a pavilion for the Decorative Arts exhibition held in Paris in 1925, for which he produced the information tower and exhibition hall of the Pavillon du Tourisme.[145] Both the tower and the main pavilion were built in reinforced clinker concrete (fig.79). The tower was made of two tall vertical slabs forming a cross, and strenghtened by horizontal planes at top and bottom. The role played by these orthogonal elements was simultaneously structural and formal. The main pavilion also exploited the constructional possibilities of concrete construction. The most striking feature of the pavilion was its interior volume. In the absence of any visible vertical supports, the viewer received the impression that the roof structure -- ceiling and side walls -- rested on a thin uninterrupted glass strip. Mallet-Stevens' virtuosity in the manipulation of reinforced-concrete construction was duly noted by critics.[146] Commenting on the pavilion project, Bruno Reichlin has recently noted that the ingenious constructional system was not pedagogically displayed but intentionally concealed, in an attempt to heighten the viewer's experience.[147] This concealment of the technical means employed was to prove central to Mallet-Stevens' conception of reinforced-concrete construction.

Mallet-Stevens was soon to exploit the technique of reinforced concrete in the construction of his first house in the Paris area, the hôtel Collinet at Boulogne-sur-Seine (1925-26).[148] Commissioned and designed in 1925, the hôtel Collinet was built on an urban lot. It relied on a mixed structural system: masonry load-bearing party walls with a

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[145] The pavilion is well illustrated in Waldemar George, "L'Exposition des Arts Décoratifs et Industriels de 1925. Les tendances Générales", L'Amour de l'Art, vol. 6, no. 8, August 1925, pp. 283-291.

[146] Lionel Landry, "L'Exposition des arts décoratifs", Art et Décoration, June 1925, p. 208.

[147] Reichlin (see note 44), p. 118.

[148] Drawings and technical information related to the hôtel Collinet have been reconstructed from various sources. See especially Ragot (see note 116), vol. 3, pp. 553-556.

series of internal reinforced-concrete posts. The floors and roof terrace were most probably in reinforced concrete. With a lot width of roughly 9 meters, the floor beams required middle supports. The row of vertical posts was placed off center in accordance with a floor plan defined by two asymmetrical bays (about 5.5 m and 3.5 m wide). The vertical posts at the various levels merged with the internal partitions. In this project, the frame was merely exploited as a substitute for the traditional supporting wall. In the absence of any external manifestation of the structural system employed, the most visible sign of reinforced-concrete construction was the cantilevered canopy on the roof terrace.

In a lecture detailing "The reasons for modern architecture in all countries" given in 1926, Mallet-Stevens offered an assessment of the rapid development of the new architecture.[149] For this architect, reinforced concrete was as a key determinant of modern house design.[150] After a quasi lyrical description of the material's discovery, Mallet-Stevens argued that the possibilities afforded by reinforced-concrete construction permitted longer spans, larger bay openings, a reduced number of load-bearing points (*points d'appui*), which could be smaller, and cantilevers.[151] These technical possibilities were to have a direct impact at the formal level: "One can easily conceive that this novel technique gives architecture a new face. The surfaces become unified, the right angle dominates, the facades are clean, legible, and sincere."[152]

For Mallet-Stevens the new architecture, which developed simultaneously on different continents, shared the same crucial feature: horizontal lines, an argument illustrated with the presentation of a villa by Frank Lloyd Wright: "What is striking is this

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149 Robert Mallet-Stevens, "Les Raisons de l'Architecture Moderne dans tous les Pays", Conférencia - Journal de l'Université des Annales, tome 2, June-December 1926, pp. 583-597.

150 Mallet-Stevens wrote: "Le moteur cet organe qui bouleverse tout, scientifiquement et plastiquement est à la voiture ce que le béton armé est à la maison: construction nouvelle, esthétique nouvelle." Mallet-Stevens (see note 149), p. 587.

151 Mallet-Stevens (see note 149), p. 589.

152 Mallet-Stevens (see note 149), p. 589: "On conçoit aisément que cette technique toute neuve donne à l'architecture un nouveau visage. Les surfaces deviennent unies, les angles droits dominent, les facades sont propres, lisibles et sincères."

will for horizontal lines, lines that can be realized only with reinforced concrete."[153] Mallet-Stevens' association of Wright's architecture with reinforced-concrete construction was not new. In a 1925 article dedicated to the architecture of Wright, Mallet-Stevens had alluded to a connection between reinforced concrete and "horizontal architecture", a connection between material and forms that was reiterated in his 1926 lecture.[154] Illustrating his argument with a number of projects by European architects, he explained how many were directly indebted to reinforced-concrete construction.[155]

A thorough description of the characteristics of the new style was also presented: grand plans, blooming volumes, naked facades, large bays, geometric lines, simplicity. The age of the building was to be defined solely by the constructional process, not by any ornamental addition. But Mallet-Stevens also added: "The modern architect has replaced small decorative details by an ensemble, a global motif. This ensemble is an enormous sculpture where light hits the large, neatly defined surfaces: it is a monumental block cut out of the mass."[156] Exploiting this metaphor, Mallet-Stevens added that the stone blocks of past architecture were to be replaced by blocks of void, and thick fortress-like walls would give way to the thin walls of reinforced-concrete construction.

This discourse on the material determinants of the new architecture was formulated at the time Mallet-Stevens was actively engaged in the realization of a group of modern houses in the Paris suburb of Auteuil. Commissioned between October 1925 and July 1926, the houses were almost all completed by December 1927.[157] The program

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153 Mallet-Stevens (see note 149), p. 590: "Ce qui frappe tout de suite, c'est cette volonté de lignes horizontales, lignes que seul le béton armé permet de réaliser."

154 Robert Mallet-Stevens, "Frank Lloyd Wright et l'architecture nouvelle", Wendingen, no. 9, 1925. The article was republished in H. T. Wijdeveld, The Life-Work of the American Architect Frank Lloyd Wright, Santpoort, C. A. Mees, 1925 [reprint: Horizon press, 1965] pp. 92-93.

155 On Guévrékian's hotel project, Mallet-Stevens wrote: "Les horizontales sont suffisamment accusés pour qu'il soit inutile que j'insiste. La façade entière est d'une belle simplicité et, sans le secours du béton armé, un tel édifice serait inconcevable." Mallet-Stevens (see note 149), p. 592.

156 Mallet-Stevens (see note 149), p. 593: "Aux motifs décoratifs de détail, l'architecte moderne a substitué un motif d'ensemble. L'ensemble est une énorme sculpture où la lumière vient buter sur de grands pans nettement déterminés: c'est un bloc monumental taillé en pleine masse."

157 [Anon.], "La rue Mallet-Stevens à Paris. - R. Mallet-Stevens, architecte", L'Architecte, vol. 4, no. 12, December 1927, p. 100, pl. 69-72, fig. 170-178 and 184-185.

comprised the construction of five houses on a dead-end street that came to be known as the rue Mallet-Stevens. The five houses bore the name of their owners: Reifenberg, Allatini, Dreyfus, Martel, and Mallet-Stevens. According to the reviewer of L'Architecte, the villas were based on a reinforced-concrete skeleton with hollow brick infill, and covered with roughcast, a cement coating (*crépi*).[158] The exterior views of the villas published at the time provide no clear contradiction of that assessment. With their cubic shapes terminated by roof terraces, the villas accorded with the current definition of the reinforced-concrete house. It can be further assumed, according to the norm, that all houses had reinforced-concrete floors and roof terraces. An analysis of the limited documentation available points, however, to the mixed nature of the structural system adopted.

The Reifenberg house is a case in point (fig.81). As Ragot clearly indicates, the plan of the house is defined by a regular grid of internal walls 35 cm thick.[159] Coupled with peripheral load-bearing walls and a number of lintels, these internal partitions could well constitute a coherent structural system based on the combination of traditional and modern masonry work. The plan further reveals the presence of four posts on the rear facade. The thickness of the external walls is emphasized by the slight recess of the window panes, especially at ground-floor level. The Allatini house presents a different case (fig.82). According to Ragot, the house's structure is based on peripheral load-bearing walls complemented by eight irregularly placed posts that allow for the successive recesses of the facade.[160] The vertical posts merge with the internal partitions. In this project, the complex configuration of the skeleton is totally derived from the complexity of the plan. Smaller than the two other houses, the Dreyfus house also exploits the possibilities of the mixed structural system (fig.83). Two load-bearing party

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[158] L'Architecte (see note 157), p. 100.

[159] Ragot (see note 116), vol. 3, p. 564. The load-bearing nature of the Reifenberg house can be further ascertained if we compare it with the masonry walls of the Gaut house. While the walls of the Reifenberg house are 35 cm thick, the load-bearing brick walls of the Gaut house are only 11 cm thick.

[160] Ragot (see note 116), vol. 3, p. 572.

walls erected on the lot line offer the primary supports for a combination of reinforced-concrete posts and supporting walls.[161] The key role played by the supporting masonry walls is blurred by the presence of corner windows and a roof-terrace canopy, made possible only through the use of iron or concrete beams. Based on a square plan, the Martel house presents a similar ambiguity. Two of its walls are blind: one is erected on the lot line, the other -- a party wall -- is shared with the next house, the Mallet-Stevens house. According to Ragot, these two blind walls coupled with the central stairwell could provide the basis of a relatively traditional structural system.[162] At the very least, this configuration encouraged the use of a mixed structural system. Finally, the Mallet-Stevens house also appears to be based on a mixed structural system: two load-bearing walls complemented with sections of internal supporting walls are combined with a series of reinforced-concrete posts. The complexities of the plan (double-height room, variations in levels, etc.) are resolved using the combined resources of modern masonry and reinforced-concrete construction.

Each of the houses on the rue Mallet-Stevens were different in size and program. Their distinctive character was stressed by means of the composition of external volume and the arrangement of window openings. This compositional variety was made possible by the absence of standardized openings. But the houses shared some formal and decorative features that indicated their kinship. Each house was covered by a white coating that gave homogeneity to the facades and was adorned with continuous prismatic stripes at the base of the ground-floor level.

The houses' formal homogeneity could be interpreted as a sign of constructional uniformity, but as the analysis has shown, the houses were probably not built with a single method or system. In all cases, the skeleton was only partial, sharing the structural task with various supporting walls. But more importantly, these partial skeletons appear

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161 Ragot (see note 116), vol. 3, p. 578. The foundations drawn on the longitudinal section clearly indicate the presence of a central supporting wall.
162 Ragot (see note 116), vol. 3, p. 587.

to have been conceived as mere alternatives to load-bearing masonry walls. The design process deduced from the few plans available seems to infer that frame elements only entered the picture after the conception of the houses was complete, in order to solve the structural problems of construction. In such a process, the use and extent of the frame is decided case by case. The configuration of the (partial) frame derives from the adopted plan, not the reverse. According to this design practice, the reinforced-concrete frame appears to play no dimensional or organizational role. The absence of a regular, regulating, frame is formally translated and shows up in the general configuration of the houses, whose floor plans are often marked by gradual recesses. It is revealed also where generally horizontal volumes are suddenly broken up by vertical elements (vertical windows in the Mallet-Stevens house, a round stairwell in the Martel house), and likewise by the compositional manipulation of window openings. The Mallet-Stevens house is a case in point. In this house, the large variety of window openings (vertical strips, square openings, oculus, corner windows) offered little clues as to the various levels and the overall configuration of the structure.

Mallet-Stevens' separation of the formal and constructional aspects of architectural design did not go unnoticed. Theo van Doesburg, an attentive observer of the French architectural scene, focused on the rue Mallet-Stevens as an important manifestation of the current building trend he coined 'orthogonal' and 'elementary'.[163] For van Doesburg, the variety found in Mallet-Stevens' architecture derived from an aesthetic and decorative concern still indebted to the teaching of the Viennese school. In Mallet-Stevens' architecture, the exterior shape was not the logical result of construction problems, but served as a starting point. "Mallet-Stevens is an 'illusionist'", Van Doesburg wrote. "meaning that he proceeds from a pre-conceived, visual beauty of forms."[164] Earlier in

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[163] Theo van Doesburg, "Three Experiments in Elementary Architecture. In Comparison: Rue Mallet-Stevens" (Het Bouwbedrijf, vol 4, no. 20, September 1927), in Theo van Doesburg. On European Architecture (see note 123), pp. 158-163.

[164] Van Doesburg (see note 123), p. 162.

1924, Le Corbusier had already noted Mallet-Stevens' fondness for form making, adding that a simple prism was preferable to an exuberance of forms.[165]

This separation of form from construction was also noted by French critics. In a review article on Mallet-Stevens published in 1927, Marie Dormoy wrote: "Though an architect, Mallet-Stevens is barely concerned by the material employed. He uses reinforced concrete because nowadays it is the most economical, the most practical, the material that permits building of long spans, that allows for realizations inconceivable only fifty years ago. But Mallet-Stevens does not 'think' reinforced concrete."[166] She also added: "Never in his facades are we able to identify the position of the structural posts."[167] Dormoy's comment was not devoid of polemical intent, for she was actively defending the doctrinal position maintained by Auguste Perret and his circle, but in so doing she clearly underlined a key aspect of Mallet-Stevens' practice: that reinforced concrete was merely instrumental to the architect's plastic research.[168]

In a recent study on Mallet-Stevens' architecture, Bruno Reichlin has written that the architect appreciated the freedom offered by new building techniques. Yet he further added that "the quality he sought in the reinforced-concrete skeleton was that it could be there while appearing as if it were not there".[169] While concealing the technical means, Reichlin explains, Mallet-Stevens resorted at times to expressing structure by means of decoration, an effect best illustrated by the tower pavilion of the 1925 Art Deco exhibition. In the vertical tower, the horizontal planes simultaneously performed both a

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[165] Le Corbusier wrote: "On peut certes affirmer qu'il a l'amour des formes et, si l'on voulait quelque peu chicaner, on dirait même qu'il les aime tant qu'il en met un peu trop." Le Corbusier (see note 73).

[166] Marie Dormoy, "Robert Mallet-Stevens", L'Amour de l'Art, vol. 8, no. 10, October 1927. pp. 373, 375: "Bien qu'architecte, Mallet-Stevens s'inquiète assez peu du matériel employé. Il se sert du béton armé parce qu'en ce moment il est le plus économique, le plus pratique, celui qui permet des portées inconnues jusqu'ici, celui qui se plie à des réalisations inconcevables il y a seulement cinquante ans. Mais Mallet-Stevens ne 'pense' pas en béton armé."

[167] Dormoy (see note 166), p. 375: "Jamais, dans ses façades, on ne soupçonne l'emplacement des poteaux de structure."

[168] For a discussion of Dormoy's argument in light of the contemporary architectural debate in France, see chapter VI.

[169] Reichlin writes: "La qualité la plus recherchée de l'ossature en béton armé semble être celle d'y être comme si elle n'y était pas." Reichlin (see note 44), p. 113.

structural and a formal function. The same horizontal planes were to reappear in the garage Marbeuf executed in 1925, but here they were used as mere decorative elements on the facade.

As the analysis of the Auteuil houses reveals, Mallet-Stevens' exploitation of the reinforced-concrete skeleton in domestic architecture was at best partial. When talking about the new technique, the architect most often referred to the localized structural possibilities offered by the system (long span or load-bearing points), but in his few published statements the terms 'frame' and 'skeleton' are never used. And more importantly, the ideas of regularity and modularity often associated with the reinforced-concrete frame goes unmentioned.

With Mallet-Stevens, the aesthetic of reinforced-concrete architecture was understood in terms of the visual conventions of masonry construction. In the houses of the rue Mallet-Stevens, the architect exploited the possibilities offered by concrete to expand, not reject, the vocabulary of masonry construction. A few compositional elements -- the corner window, the large glass opening of the ground-floor studio -- subverted the logic of masonry construction. But the general composition based on the manipulation of volumes reinforced the perception of the wall as a solid, homogeneous entity. The slight pyramidal configuration of the volumes induced the perception of the walls as load-bearing elements. The resulting volumes give an impression of compact mass, not of hovering horizontal elements. This impression of compactness was reinforced by the treatment of window openings. Mallet-Stevens still conceived the window as a hole punched in the masonry wall. The perception of the wall as a "thin solid" was emphasized by the slight recess of the window panes and the contours of their frame. This perception of the wall as a load-bearing element was further emphasized by the prismatic decorative stripes that anchored the houses to the ground. With the cubic mass of the houses firmly attached to the ground, Mallet-Stevens' conception of the reinforced-concrete aesthetic did not depart from the visual tradition of masonry construction.

André Lurçat and the signs of reinforced-concrete construction

Between 1924 and 1927, André Lurçat was actively involved in the construction of modern houses in the Paris area. Trained at the Ecole des Beaux-Arts, from which he graduated in November 1923, Lurçat worked with the architect Henri Pacon from January 1920 to August 1924.[170] While his training did not predispose him to modern materials, the projects Lurçat exhibited at the Galerie Mosser in January 1924 were directly associated with the idea of reinforced-concrete construction. These projects were variations on the idea of mass housing. The role of the material was clearly spelled out on the invitation card that described the project for a double house: "REINFORCED CONCRETE. Time saving for construction. Money saving. Saving of space (the walls are thinner). Concrete was criticized: resonance, coldness: Answer: hollow floors, hollow walls.... Cement is not revolutionary, it is traditional."[171] This conception of modern construction methods was further developed in his theoretical project for mass housing, a series of craftsman's ateliers (1924) (fig.84).[172] Defined according to the prescriptions of the Ribot Law, the small standardized cubic ateliers were to be built with modern materials: reinforced concrete combined with hollow cement blocks for the walls and the terrace.[173] The masonry walls were to be 24 cm thick, including the external and internal coating. Contrary to the technique adopted by Perret in the maison Gaut, Lurçat advocated the use of a single cement block. The terrace was to be made of hollow blocks

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170 Cohen (see note 4), pp. 19-23.

171 Invitation card: "BETON ARME. Economie de temps de construction. Economie d'argent. Economie de place (moindre épaisseur des murs). On reprochait au Béton: sonorité, froid : Réponse : planchers creux: murs creux (...). Le Ciment n'est pas révolutionnaire, il est traditionnel !" (Fonds Lurçat, 533 AP 24/004)

172 [A. Lurçat], "Architecture et Urbanisme. Une groupe d'ateliers par André Lurçat", Clarté, January 1925, pp. 25-26 (Fonds Lurçat, 533 AP 25/004)

173 Lurçat wrote: "Le ciment armé s'impose donc, et avec lui les murs en corps creux, et la terrasse en corps creux également... Le bois, financièrement, est vaincu par le ciment." [A. Lurçat] (see note 172).

supported by cement joists. In this project, the cement-block walls performed a load-bearing function. For Lurçat, this extensive use of cement avoided the engagement of many building trades. A single entrepreneur could almost build the entire house.

These theoretical proposals for mass housing were undoubtedly influential in the conception of Lurçat's first modern house: the maison Rousset at Eaubonne (1924-25). The maison Rousset appeared as a two-story-high unadorned cubic house with a smooth white finish, the epitome of the modern cement house described by Veissière in 1924 (fig.85). In the June 1925 issue of L'Art décoratif moderne, the maison Rousset was presented as a house built in reinforced concrete.[174] Yet in view of the dimensions and openings of the house, it could well have been built with load-bearing walls, adopting a technique similar to the one advocated in Lurçat's theoretical projects.[175] In these early projects, Lurçat's exploitation of reinforced concrete was clearly conceived within the technical and visual framework of modern masonry construction.

Between 1924 and 1927, Lurçat designed eight house-studios built on the urban subdivision that came to be called Cité Seurat. Commissioned between July 1924 and January 1926, most of the houses were completed by 1927. For the reviewer of a construction journal, the Cité Seurat was a triumph of reinforced concrete, for "all the elements of architecture: beams, balconies, staircases, cornices highlighted its numerous qualities."[176] Since they were erected on urban lots, the houses of the Cité Seurat were all constrained by the presence of party walls. The first house to be built was commissioned by his brother the artist Jean Lurçat in July 1924 (fig.86). The three-story house was based on an L-shaped plan and its main structure was constituted by load-bearing masonry walls.[177] The two load-bearing walls on the property line acted as

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174 L'Art décoratif moderne, June 1925.

175 The lack of available documents on the house makes it difficult to confirm this point. Only an examination of the house *in situ* (if it is still extant) would confirm or disprove this assertion.

176 [H. M.], "La Cité Seurat de Montsouris", La Technique des Travaux, September 1927, p. 413: "La Cité Seurat est un triomphe pour le ciment armé; tous les éléments d'architecture: poutres, balcons, escaliers, corniches mettent en relief ses nombreuses qualités."

177 For a description of the house, see Jean-Louis Cohen, "L'architecture d'André Lurçat (1894-1970): autocritique d'un moderne", doctoral dissertation, Paris, EHESS, 1985, vol. 1, p. 118.

traditional party walls. As the plans seem to suggest, these walls were probably made of rough stone (fig.87).[178] The other peripheral walls that constituted the volume of the house also performed a load-bearing function. These external walls were apparently made of hollow cement blocks. Finally, a small supporting wall was located inside the house parallel to the staircase. A number of reinforced-concrete beams constituted the supporting frame for the foundations and floors. The construction drawings reveal that each of the beams were calculated according to their position and load-bearing function.[179] The floors and roof-terrace structure in reinforced concrete were built with the P.I.M.A. system of partial prefabrication developed by the entrepreneur G. Summer (fig.88).[180] The system consisted in the fabrication on the building site of joists in reinforced concrete. In the Lurçat house, the sole manifestation of structural tension was the corner window of the third-floor studio, an opening that was made possible by the use of a metal post to support the lintel above. The exterior wall surfaces were homogenized by a white coating of *ciment-pierre* (lithogène) giving uniformity to the entire volume while concealing the traces of the masonry construction.

The second project to be built, the double house commissioned in December 1924 by the painters Edouard Goerg and Marcel Gromaire, was based on the same construction methods. The structure of the house was based on lateral party walls in rough stone, with the facades and internal masonry walls made of hollow cement blocks.[181] It can be assumed that reinforced-concrete beams constituted the supporting frame for the foundations and floors. Moreover, two photographic views of the building site tend to indicate that the floors were also made with the P.I.M.A. system.[182]

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178 Final project, floor plans, undated (Fonds Lurçat, 533 AP 001/02).
179 Construction drawings, foundations beams, undated (Fonds Lurçat, 535 AP 001/16).
180 Construction drawings, floor plans, undated (Fonds Lurçat, 533 AP 001/15). Describing the P.I.M.A. system, a reviewer wrote: "Ce système qui supprime totalement les coffrages et étais coûteux et encombrants a permis de réaliser une économie sérieuse de temps et d'argent." [H. M.] (see note 176), p. 413.
181 Cohen (see note 177), vol. 1, p. 130.
182 Cohen (see note 177), vol. 1, pp. 130-131. According to Jean-Louis Cohen, however, the floors in reinforced concrete were crafted with traditional formworks.

Two other houses -- the Bertrand and Huggler houses -- made use of the mixed structural system. Commissioned in January 1925, the Bertrand house combined traditional party walls with a double row of reinforced-concrete posts. According to Ragot, this vertical structure divided the house into three irregular sections perpendicular to the street, with widths of 4 meters, 4.8 meters, and 3.6 meters respectively.[183] This tripartite division was reproduced at each level, with the vertical posts merged with the partition walls. The Huggler house, commissioned in January 1926, was based on a similar system. The two parallel rows of reinforced-concrete posts formed an irregular grid. The vertical posts, coupled with reinforced-concrete beams, offered the supporting structure necessary for the floors, terraces, and double-height room of the studio. All of the posts, except for one, were concealed within the thickness of the partitions or wall storages.[184]

At the Cité Seurat, Lurçat made limited exploitation of the structural possibilities of reinforced-concrete construction, partly because of an urban context in which the use of party walls was probably encouraged by building regulations. Yet it was also the result of a reliance on the possibilities offered by the technique of modern masonry itself. The simple cubic volumes of Lurçat's early urban projects, where the masonry envelope conditioned architectural expression, accurately translated their technical nature. In fact, Lurçat's exploitation of reinforced concrete was made most legible at the level of horizontal architectural elements. With the external staircases and small cantilevered balconies, Lurçat provided timid yet clear signs of the active presence of a modern construction system.

During the development of the Cité Seurat, Lurçat was also involved in the conception of houses for suburban sites. Freed from the constraints of urban lots, these projects supply additional information regarding Lurçat's approach to reinforced-concrete construction. The villa Bomsel in Versailles, a single house built on an isolated lot, is a

[183] Ragot (see note 116), vol. 3, p. 459.
[184] Ragot (see note 116), vol. 3, p. 483.

case in point (fig.89). Commissioned in December 1924 and begun in June 1925, the villa was completed in July 1926. For the reviewer of L'Architecte, the frame was in reinforced concrete, the walls made of a double facing with infill.[185] But an analysis of the available construction drawings reveals that the villa was erected with peripheral masonry walls complemented by a number of vertical posts. Even where the context permitted the adoption of a structural skeleton, Lurçat seemed to favor the mixed construction system. As in all his other projects, reinforced concrete was used for foundations, floors and the terrace structure.[186] Here the structural posts did not play the role of an embryonic frame, regulating and dimensioning the entire house, but were rather specifically positioned to assist the construction of specific elements: the rectangular bow window on the garden side, and the openings and balcony on the street side. In fact, the possibilities of reinforced concrete were mostly used for the construction of a number of isolated architectural elements that projected outward from the cubic volume: the round bow window, external staircase, and balcony on the street side, and the staircase and large balcony on the garden side. The large garden-side balcony was further supported by a conspicuous pilotis. These protruding elements were direct expressions of the cantilever permitted by reinforced concrete construction. In traditional masonry construction, external projections were commonly signaled by an affirmation of the connection between vertical and horizontal elements. By contrast, reinforced-concrete construction came to be characterized by the absence of demonstrative signs of structural connection.[187] Attached to the two facades of the villa Bomsel, these projections were an overt manifestation of the formal possibilities offered by modern building techniques.

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[185] [Anonymous], "Hôtel particulier à Versailles. A. Lurçat", L'Architecte, no. 10, October 1926, p. 80, pl. 60.

[186] Based on a reading of the execution drawings dated 1 September 1925, Cohen explains that reinforced concrete was solely used for the floors, lintels, and staircases. Cohen (see note 177), vol. 1, p. 156.

[187] On the expression of the cantilever, Simonnet writes: "Les porte-à-faux qu'autorise le béton armé font travailler la matière en un point particulier, qui est celui de la jonction entre horizontal et vertical -- lieu privilégié de l'architectonique classique qui y concentrait volontier sa puissance décorative. Mais le travail du porte-à-faux n'est pas perceptible, nul signe ne le prend en charge, sinon celui de son immatérialité ou de son dépouillement technique." Cyrille Simonnet, "Matériau et architecture. Le béton armé: origine, invention, esthétique", doctoral dissertation, Paris, EHESS, 1994, vol. 3, p. 384.

Also built in Versailles, the villa Michel was commissioned in February 1925 and completed in the fall of 1926 (fig.90). It was, apparently, based on the same mixed construction system as was adopted for the villa Bomsel, and like the villa Bomsel was conceived as a compact rectangular volume broken up by relief elements on the street and garden sides.[188] In an interview published in 1926, Lurçat declared that the house was built in reinforced concrete and hollow blocks, and that it could be built in six months for a relatively low cost.[189] According to Cohen, Lurçat was later to argue that the house was conceived so as to be reproducible.[190] Lurçat's mention of building cost and construction time certainly suggest a relation to mass housing. The idea of reproduction was also indicated in the configuration of the interior plan. By contrast with the villa Bomsel, the plan of the villa Michel displayed a greater regularity in terms of room shapes and dimensions. This regularity was translated on the street facade, with the regular spacing of window openings. This dimensional and facade regularity accorded with the idea of the regular structural frame. The idea of frame construction was further denoted by the two long strip windows on the garden side, announcing a timid reversal of the formal conventions of masonry construction.

Lurçat's concern for the development of an architecture based on repeatability and dimensional standardization was most clearly expressed in his theoretical projects of the second half of the 1920s. The Lotissement Soleil of 1925, the Lotissement de résidences bourgeoises of 1926, and the Groupement d'hôtels particuliers of 1927 offered a clear demonstration of the architect's interest in typological research. The drawings of the Lotissement Soleil clearly reveal that the basic housing unit was to rely on the structural quality provided by masonry walls.[191] By contrast, the main housing unit of the Lotissement de résidences bourgeoises displays a row of pilotis at the ground-floor level,

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188 The Lurçat Archive does not contain any dossier relative to this house.
189 Lurçat in L'organisation ménagère, no. 11, 15 march 1926, pp. 13-15. (Cited in Cohen [see note 177], vol. 1, p. 164).
190 Cohen (see note 177), vol. 1, p. 164.
191 Cohen (see note 4), p. 50.

implying the presence of a global structural frame.[192] These few projects are indicative of the fact that Lurçat did not necessarily resist the use of skeleton construction, but it also shows that even in the case of buildings conceived in terms of repeatability, Lurçat could remain faithful to the technique of modern masonry construction.

The idea of standardization embedded in mass-housing projects contrasted with the custom-made structural frames of Lurçat's single-house projects, as is indicated by the realization of the maison Guggenbühl in Paris, commissioned in July 1926 and completed in July 1927. As the construction drawings reveal, the structure of the house combined two traditional party walls with a modern masonry wall on the street side and a good number of concrete posts (fig.91).[193] All horizontal structures: the foundations, floors, and roof terrace, as well as a number of elements such as external and internal staircases and roof canopy, were in reinforced concrete. The construction drawings reveal the irregular placement of the vertical posts, positioned to accommodate the asymmetry of the plan. In this house the skeleton was custom-made, fulfilling the structural contingencies of site and plan. The construction drawings also reveal the great dimensional variation of the many structural elements, mostly beams and lintels, that complete the horizontal structure. Each structural element is carefully dimensioned and calculated to perform its specific load-bearing function. The use of reinforced concrete in this project was extensive, invading all parts of the building, yet it was mostly the high rectangular bow window and the large cantilevered canopy of the roof terrace that signalled the possibilities offered by modern construction techniques. Concealed within the mass of the modern masonry cube, reinforced concrete found its most potent expression by means of totemic but isolated architectural elements.

Lurçat's discourse on the question of materials was much less elaborate than that of Mallet-Stevens. In a brief assessment on the situation of architecture in 1926, Lurçat

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192 Cohen (see note 4), p. 51.

193 Maison Guggenbühl, construction drawings: number 008/14, 008/15, 008/16, 008/19, 008/20, 008/23, 008/25 (Fonds Lurçat, 533 AP 008)

explained that modern French architects sought to realize projects that united plastic and constructional qualities.[194] He added that this search was guided by building materials, leading inevitably to "unity of aspect and simplicity of expression".[195] In a lecture given in 1927, Lurçat was more explicit about the potential impact of reinforced-concrete construction.[196] From the outset, he called for the rejection of the elements of traditional architecture: columns and pillars, cornices and *entablatures*, ornate capitals. According to him, these elements had become useless since the material employed was no longer worked with chisels but molded.[197] Devoid of external ornament, the modern house -- characterized by its flat wall surfaces and cubic shape -- was only naturally made of reinforced concrete. But Lurçat went even further. Envisioning a time when concrete construction would do away with traditional formwork, Lurçat advanced the prediction that large elements of the house would soon be fabricated in workshops. Poured as single pieces, these large concrete wall sections would be hoisted on the building site. The system described by Lurçat was very similar to the Bron system of prefabricated concrete that was currently employed in the Siedlung of the Friedrichsfelde suburb near Berlin.[198] His knowledge of the Bron system was most probably indebted to a recent trip to Germany, during which time he visited a number of Berlin Siedlungen.[199] Going beyond the more conventional idea of skeleton construction, Lurçat hinted at his interest in the potential offered by the heavy industrialization of reinforced-concrete construction.

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194 A. Lurçat, "Son bilan avant l'effort actuel: la tradition abandonnée depuis 1820, un siècle de perdu", Sept Arts, December 1926. In the English version published in the catalogue Machine-Age Exposition (New York, Little Review, May 1927), the text is dated January 1926.

195 Lurçat wrote: "Tous, nous avons commencé par nous dépouiller complètement de toutes formules décoratives, suivant seulement les matériaux qui amènent inévitablement l'unité d'aspect et la simplicité d'expression, bases nécessaires et rigoureuses pour l'avènement d'une plastique nouvelle." Lurcat (see note 192).

196 Organized by the Comité Paris-Nancy, the conference was given the 20 May 1927 in Nancy.

197 Lurçat, cited in "L'Architecture", L'étoile de l'Est, May 1927 (Fonds Lurçat, 533 AP 26).

198 See Richard Pommer, Christian F. Otto, Weissenhof 1927 and the Modern Movement in Architecture, Chicago and London, The University of Chicago Press, 1991, p. 65. For a description of the system, see Helen Searing, "Betondorp: Amsterdam's Concrete Garden Suburb", Assemblage, no. 3, July 1987, p. 141.

199 Lurçat went to Germany for the inauguration of the Bauhaus buildings in Dessau in December 1926. Cohen (see note 4), p. 76.

In his domestic architecture of the mid-1920s, Lurçat approached reinforced concrete as an outgrowth of masonry construction, not as a technique that transformed the mode of conception and production of the house. In his early projects, reinforced concrete was mostly used for horizontal structures, as a complement to masonry construction. Lurçat did not seem to conceive the modern house primarily in terms of skeleton construction. It was only progressively that vertical frame elements were to develop, complementing the load-bearing masonry structures, and it is only gradually that Lurçat came to exploit and express the possibilities offered by frame construction.[200]

In a 1926 article, Gaston Varenne viewed Lurçat's recent realizations as a move away from cubism towards a renewed, temperate, modernized baroque that allowed the reintroduction of moldings and the curve, the only baroque features permitted by reinforced concrete.[201] This reading contrasted with Varenne's 1924 evaluation of the new architecture in terms of the stern concrete cubic house.[202] For Varenne, the reintroduction of the curve in Lurçat's project was a sure sign of positive developments in the new architecture. The attempt to break up the cubic volume was already present in some of Lurcat's projects for the cité Seurat. Yet it is with the single house projects that this search was made more obvious. For Varenne, the move away from the box was revealed by the use of architectural elements that projected out from the facade [*architectural contrepoint*]. It is by means of these object-signs that Lurçat was to define his aesthetic of reinforced-concrete construction.

3. Le Corbusier and the Subversion of the masonry Model (1924-27)

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200 In a review of Lurçat's work, H. Achel wrote that the "consequences" of reinforced-concrete construction exploited by the architect were the long cantilevered span, the large corner windows, and the horizontal strip window. Henri Achel, "André Lurçat, architecte", L'Architecture, vol. 40, no. 4, 15 April 1927, pp. 113-116.

201 Gaston Varenne, "Quelques constructions récentes d'André Lurçat", La Demeure française, no. 3, Fall 1926, pp. 55-58.

202 Varenne (see note 11), p. 370.

In contrast with the conceptions of Mallet-Stevens and Lurçat, Le Corbusier 's approach to the construction of the modern house was intimately related to his interest in the industrialization of the frame. The idea of the concrete frame as the generator of a specific house type had been first formulated in the context of the Dom-ino project initiated in 1914. This idea of the concrete frame as an alternative to masonry structures was further developed in his Citrohan projects of the early 1920s. It is with the Citrohan project of 1922 that Le Corbusier studied the shift from masonry to frame construction, a study rooted in his belief in the industrialization of the concrete frame.

Le Corbusier and the industrialization of the frame

The first Citrohan project presented in the 1921 Esprit Nouveau article was based on longitudinal load-bearing walls that supported the standard transverse floor beams.[203] Returning to this project in 1921, Le Corbusier adapted the Citrohan house-type to the reinforced-concrete frame.[204] Describing this project in Vers une architecture, Le Corbusier wrote: "Skeleton made of reinforced-concrete trusses lifted up with a winch."(fig.92)[205] The description of the Citrohan house given in L'Amour de l'Art was more precise. "Its skeleton is made of concrete. The concrete posts, poured on the ground, then hoisted and connected with transverse beams, make it possible to do away with wooden formwork and greatly simplify the construction process."[206] According to this description, the main structural elements were to be cast in molds and lifted into position after setting. Taking up the system of prefabrication proposed for the Dom-ino house, Le Corbusier adapted the dimensions of the frame elements to a pre-existing house-type.

203 Le Corbusier-Saugnier (see note 126), p. 1539.
204 In Vers une architecture (1923), the second Citrohan project is dated 1921. In the Oeuvre complète (1929), Le Corbusier mentions only 1922, the date of its presentation at the Salon d'Automne.
205 Le Corbusier, Vers une architecture, Paris, Crès, 1923, p. 201: "Ossature en fermes de béton coulées à pied d'oeuvre et dressées au treuil."
206 Waldemar George, "IV. L'Art Urbain", L'Amour de l'Art, vol. 3, no. 11, November 1922, p. 360."Son ossature est faite en béton. Les charpentes en béton, coulées à plat, redressées et reliées par des traverses, permettent d'éviter les coffrage de bois et simplifient singulièrement la construction."

In France, Le Corbusier was not alone in advocating the prefabrication of concrete elements. A few architects trained under Anatole de Baudot were equally convinced of the need to approach reinforced-concrete construction in terms of prefabrication. It is with a system of prefabricated concrete elements that the diocesan architect Henri Deneux had executed the reconstruction of the roof of Rheims cathedral between 1919 and 1925. Patented in 1919, the system was based on trusses that could be assembled without mortar.[207] Prefabrication of concrete construction was also advocated by the architect Charles-Henri Besnard.[208] Following his early experiments with the firm Bessonneau, Besnard pursued his research with the construction of the church St-Christophe de Javel (1922-28) in Paris, a project in which all the structural elements -- together with their molded decoration -- were prefabricated on the building site.[209] This research into prefabrication was pursued in the context of the Art Deco exhibition with the construction of the pavilion of the Société des Arts Appliqués aux Métiers.[210] The molded elements -- a kind of monolithic panel -- formed both the structure and the envelope of the building. Despite its decorative apparatus, Besnard's system of wall panels had similarities with the concrete building systems experimented with in the Netherlands in the early 1920s. Some of the systems used at Betondorp, the Concrete Garden surburb near Amsterdam, were based on large prefabricated building elements in reinforced concrete.[211]

By definition, the prefabrication of reinforced concrete implied the assemblage of individual parts, a practice that was to be severely criticized by some architects, leading advocates of reinforced-concrete construction. For Auguste Perret, prefabrication stood in contradiction of the fundamental principle of the new material, namely monolithism.

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207 Henri Deneux, "La nouvelle charpente de la cathédrale de Reims, en éléments de ciment armé assemblés et démontables", La Technique des Travaux, no. 7, July 1926.

208 For a defence of industrial methods and prefabrication, see Charles-Henri Besnard, L'Art Décoratif Moderne et les Industries d'Art Contemporaines, Paris, Henri Laurens, 1925.

209 Charles-Henri Besnard, L'Eglise Saint-Christophe de Javel. Description raisonnée, Paris, Imprimerie J. Mersch, 1930.

210 On this project, see my note: "Paris 1925: an exhibition pavilion", Rassegna, vol. 14, no. 49, March 1992, p. 55.

211 Searing (see note 198), pp. 109-143.

This principle was rooted in the pre-war definition of the technique enshrined in the *Circulaire ministérielle* of 1906.[212] In an unpublished study on Perret's work, Marcel Mayer wrote in 1926: "Regarding this question [of prefabrication], it is important to note that A.G. Perret do not approve of the concrete construction system that consists in the assemblage of standardized elements molded in advance. This method can only be used for infills. Applied to the structure, it turns every joint into a weak point. To build in concrete, that is to say to built in a solid and durable way, implies that the entire framework must be poured at once to make of it a true monolith." [213] For the architect Paul Guadet -- a former colleague of Auguste Perret and an expert in reinforced-concrete construction -- monolithism was also a key structural property of the material. Making an overt critique of prefabrication, Guadet wrote in 1926: "One of the great advantages of reinforced concrete, one that accounts for it its success, is the resulting monolithism of construction. As a matter of fact, it condemns all the processes in which the elements molded in advance are then assembled like an iron structure."[214] When assemblage was necessary, Guadet added, the use of a metal framework was deemed preferable to prefabricated-concrete elements.

Le Corbusier's interest in the prefabrication of the modern frame was to be largely amended once he was confronted with the constraints actual building. The occasion to test his ideas on industrialization on a large scale came in November 1923 when he was invited by the industrialist Henri Frugès to build a small housing project at Lège.[215] The houses were based on a post-and-beam structure in reinforced concrete to be poured *in*

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212 See chapter II.

213 Mayer (see note 127), p. 140: "A ce sujet, il est utile de noter que A.G. Perret n'approuvent pas le système de construction en béton qui consiste à assembler des éléments standardisés moulés d'avance. Ce procédé ne peut convenir qu'aux remplissages. Appliqué à la structure, il fait de chaque jointure un point faible. Construire en béton, c'est-à-dire d'une façon solide et durable, c'est couler toute ossature en même temps et en faire un monolithe véritable."

214 Paul Guadet, "L'esthétique du béton armé", L'Emulation, 1926, p. 5: "Un des énormes avantages du béton armé et ce qui a fait en partie son succès, c'est le monolithisme qu'il assure à la construction - et ceci, soit dit en passant, condamne les procédés, aussi ingénieux soient-ils, où les éléments sont moulés d'avance puis montés ou assemblés comme les éléments d'une charpente en fer."

215 On Lège and Pessac, see Brian B. Taylor (see note 43).

situ, that is, with traditional wooden formworks. Early experimentation conducted in July 1924 led to the decision to set the dimensions of the basic framework at 5 m x 5 m, and to standardize the beam lengths at 5 and 2.5 meters (fig.93). Prefabrication was only applied to the structural elements of the floors. The most explicit manifestation of the idea of industrialization was in the construction of the walls, which were to be built with the Cement Gun, the sprayed-cement system commercialized by the Ingersoll-Rand Company. The cement was sprayed on the wire mesh and the formwork set between the structural members of the frame. In such a system, both frame and infill were thus made of the same basic material. The test case at Lège triggered an improvement upon this construction technique. The system of formworks for both floors and walls was modified in order to facilitate their reuse. For the floors, the new method consisted in the employment of "prefabricated, curved metal forms set between the joists, onto which concrete was poured... The metal forms were subsequently removed from below and reused."[216]

It is only after these early experiments that the commission for the construction of 130 houses at Pessac (1924-26) was given. The Pessac houses were also based on a standardized post-and-beam skeleton poured *in situ.* The drawings detailing the confection of the wall infill show a frame without seam, a design that ensured the homogeneity of the reinforced-concrete structure. With the arrival of a new general contractor in the summer of 1925, the method of wall construction shifted from the technique of sprayed cement to the more traditional masonry blocks. The ideal of industrialization had encountered the reality of the building site. Though the structural system was standardized, it was not prefabricated. And where prefabrication was implemented, it was for the construction of the formworks, not for the building elements themselves.

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216 Taylor (see note 43), p. 11.

Le Corbusier's most compelling demonstration of industrialization was in the construction of the Esprit Nouveau pavilion at the Art Deco exhibition of 1925. The pavilion contained a model apartment conceived as one unit extracted from a vast apartment block, the "Immeuble-villas" exhibited by Le Corbusier in the form of drawings at the 1922 Salon d'Automne. The exemplary role of the pavilion was clearly stated in the Almanach d'Architecture Moderne: "The Esprit Nouveau pavilion responded to a program of industrialization and aesthetics; its realization would be impossible without the new materials and techniques that are at the basis of its conception, purely and simply."[217] For the construction of the exhibit, Le Corbusier insisted to employ real materials and building processes instead of the traditional plaster, staff, and wire-netting used in ephemeral exhibition pavilions. He added that the pavilion was entirely built with standardized elements.

The structure was based on a reinforced-concrete frame made of 37 posts variably spaced by 5 or 2.5 meters in one direction and 3 meters in the other direction (fig.94). The concrete joists of the floors were mass produced on the site. The dimensions of the ribbon windows were standardized, and derived from the dimensions of the frame: "The basic element of these windows is the 5-meter bay provided by the structural span of low-cost floors in reinforced concrete."[218] The floors were built with the P.I.M.A. system, a prefabrication method developed by the entrepreneur G. Summer, which involved the fabrication on the building site of joists in reinforced concrete. The joists, made of concrete poured in molds placed on the ground, were put in place after setting.[219] The joists supported the formwork used to pour the concrete slab, an alternative to the floor infill made of hollow cement blocks. For Le Corbusier, the

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217 Le Corbusier, Almanach d'Architecture Moderne, Paris, Crès, 1926, p. 190: "Le Pavillon de l'Esprit Nouveau répondait à un programme d'industrialisation et d'esthétique; sa réalisation ne pouvait être disjointe des procédés et des matériaux nouveaux qui sont la question elle-même, purement et simplement."

218 Le Corbusier (see note 217), p. 140: "L'élément de base de ces fenêtres est la travée de 5 mètres fournie normalement par l'entre-poteaux des systèmes économiques de planchers en ciment armé."

219 Le Corbusier (see note 217), p. 190.

fundamental problem of the material resided in the crafting of the mold, the formwork: "Reinforced cement is akin to a cold cast-iron poured in a mold. The problem of its implementation is the formwork.... If on the one hand one rarely sees innovations dealing with the statics of reinforced concrete, on the other hand there are numerous propositions relative to the elimination or simplification of the formwork."[220] For Le Corbusier, the prefabrication of reinforced-concrete construction thus came to be conceived in terms of repeatable elements by means of reusable molds or formworks.

Le Corbusier and the subversion of the masonry model

The concrete frame was central to Le Corbusier's conception of modern mass-housing construction. It was also to guide his conception of single house projects. The villa Besnus, completed in December 1923, was based on a standard reinforced-concrete frame poured *in situ*. Though the frame was custom made, its dimensions were similar to those adopted for the Citrohan house of 1921. The shape and dimensions of urban sites, together with building regulations, were major constraints on the conception of urban projects. The standard dimensions implied by the frame were also to be challenged by the specific requirements of individual house project. The construction of the atelier Ozenfant provides such an instance.

Commissioned in 1923, the atelier Ozenfant was completed in early 1924.[221] Both the design and execution process underwent many changes. The irregularity of the site and the possibility of building two party walls prevented the design of a standard frame (fig.95). The structure was made of two load-bearing party walls in brick 22 cm thick

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220 Le Corbusier (see note 217), p. 190: "Le ciment armé est en somme une fonte à froid coulée dans un moule. Le problème de mise en oeuvre du ciment armé est le coffrage... Si l'on voit rarement apparaître des nouveautés aux solutions statiques du ciment armé, par contre on enregistre d'innombrables propositions relatives à la suppression ou à la simplification des coffrages."

221 The dating of the project is unclear. According to Benton, the atelier Ozenfant was commissioned and built in 1923. Benton (see note 132), p. 220. According to Ragot, the house was commissioned in late 1922, and only completed towards the end of 1924. Ragot (see note 116), vol. 2, p. 295.

combined with reinforced-concrete posts.[222] The floors were made of hollow cement blocks supported by reinforced-concrete joists. The roof structure in reinforced concrete was completed with industrial roof sheds. The combination of horizontal windows on the first floor, with large square windows for the double-height studio space gave the upper part of the atelier Ozenfant the appearance of a light empty cube. But the reduced openings on the ground floor, together with the projecting sill that was carried around the side, gave the base of the cube a weightier character. The atelier Ozenfant thus embodied a confrontation between the possibilities offered by the reinforced-concrete frame and the conventions of masonry construction.

In the atelier Ozenfant, Le Corbusier exploited the concrete frame primarily to enlarge the size of wall openings.[223] With the double villa La Roche-Jeanneret (1923-25) built in Auteuil, the concrete frame was used to challenge the conventions of masonry construction. The design of the double villa was a complex process, intimately related to Le Corbusier's successive schemes for the square du Docteur-Blanche devised between March and May 1923. Commissioned in the spring of 1923, the villa Jeanneret was part of a scheme for three villas. The villa La Roche, commissioned in July 1923, was integrated into the scheme during the summer of that same year. The project was revised in August and gradually modified between September 1923 and February 1924 (fig.96). Construction of the two houses began right after the acceptance of the revised plans and estimate, done respectively in February and March 1924. The building structure (*gros oeuvre*) was completed in the fall of 1924 and the double villa was occupied in March 1925.

Located at the far end of a private dead-end road, the double house was to be built on a site that combined urban and suburban conditions. The schedule of conditions (*cahier des charges*) prepared by the architect are not known, but the tenders submitted

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222 Tender by Pierre Vié, entrepreneur, 10 April 1923. Benton (see note 132), p. 31; Ragot (see note 116), vol. 2, p. 295.
223 The same can be said of the maison Besnus (1923), and the maison Jeanneret (1924-25) at Corseaux.

for the villa Jeanneret offer a good description of the building structure. According to the tender submitted by the entrepreneur F. Guilbaud, the reinforced-concrete floors were to rest on masonry walls.[224] This structure was to be complemented by four reinforced-concrete posts in the center and on the facade of the building. Load-bearing masonry was to be used for the side and back walls.[225] The floors were to be made of hollow cement blocks with cement joists, or any other system chosen by the entrepreneur. The estimate also specified the different types and quality of masonry adopted for each part of the building.

The estimate submitted in another tender, from the general contractor Kuntz & Pigeard, proposed a different system of construction.[226] For this contractor, the general structure of the villa was to be based on a reinforced-concrete frame. The load-bearing posts were to rest on a series of concrete blocks. The infill of the wall facade was to be made of clinker concrete. Moreover, the party walls -- probably the side walls -- were to be made of clinker concrete 25 cm thick reinforced with the appropriate armature. In their estimate, Kuntz & Pigeard proposed the replacement of all masonry work indicated in the *cahier des charges* (especially the interior partitions in brick), with partitions in reinforced clinker concrete.[227] In fact, the contractor suggested the use of clinker concrete for both the wall infill and the load-bearing party walls. This proposal can be understood in light of the firm's specific expertise. As an entrepreneur specialized in "Travaux Publics et Particuliers", Kuntz & Pigeard was more naturally inclined to favour the building techniques commonly employed in public works. These different tenders are indicative of the potential influence the construction industry could have on the ultimate choice of

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[224] Tender by F. Guilbaud, Entreprise Générale de Travaux Particuliers, 25 November 1923 (FLC H1-2-126/130).

[225] The estimate reads: "Il est prévu que les planchers seront en béton armé et reposeront sur les murs en maçonnerie, 4 poteaux en béton armé dans le centre et sur la façade de la construction complèterent la structure." Tender by F. Guilbaud (see note 224).

[226] Tender by Kuntz & Pigeard, Travaux Publics et Particuliers, 30 January 1924 (FLC H1-3-72/73).

[227] The estimate reads: "Les cloisons intérieures (...) prévues au cahier des charges en briques, seront exécutées en béton de machefer, avec mortier batard, armé." Tender by Kuntz & Pigeard (see note 226).

structural system and building technique. They also reveal how different structural solutions could very well accommodate a single aesthetic program.

The contract for the construction of both houses was given finally to another firm, G. Summer, developer of the P.I.M.A. system.[228] The general structure of the villa Jeanneret was to be based on a combination of load-bearing masonry walls on three sides with a reinforced-concrete frame on the facade. The floors, roof terrace, lintels, staircases, and parapets were all in reinforced concrete. The general structure of the villa La Roche was similar, except for the gallery wing, which made greater use of reinforced concrete. As such, the double house was to be based on a complex and heterogeneous combination of reinforced-concrete structural elements with load-bearing and infill masonry walls. Kuntz & Pigeard's proposal to erect an independent concrete frame while providing specifications on the construction of load-bearing walls is indicative of probable urban regulations. But Summer's adoption of a third load-bearing wall at the rear of the building truly suggests that in this project the standardized and autonomous frame was not central to the conception.

As with the villa Besnus, the entrepreneur provided both plans and calculations for the reinforced-concrete structure.[229] As a general contractor, Summer was in charge of the concrete structure, the floors, and the various masonry walls. The technical drawings provide a listing of the reinforced-concrete floor joists. The curve of the La Roche gallery required the calculation of a series of custom made joists; each rib was given an individual entry noting its dimension and configuration (fig.97). The floors were again, apparently, built with the P.I.M.A. system.[230] In fact, the construction method adopted for the villa La Roche-Jeanneret did not differ from the one used in the villa Besnus, the

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228 Benton (see note 132), p. 62.

229 Summer was involved in the construction of the villas Besnus, La Roche-Jeanneret, Cook, Planeix, Stein-de-Monzie and Church. Benton (see note 132), p. 224.

230 Benton alludes to the fact that the floors of the double villa were probably built with the P.I.M.A. system developed by Summer. So far, I have not been able to confirm or disprove this assertion. Tim Benton, "Six houses", Le Corbusier Architect of the Century, London, Arts Council of Great Britain, 1987, p. 50.

main difference residing at the level of architectural language. At the villa Besnus, the building system employed served to materialize a closed, solid "cubist" block firmly attached to the ground, despite the use of pillars for part of the basement foundation. Moreover, the long window openings did did not reach the wall end, respecting the visual and material integrity of the cube. With the villa La Roche-Jeanneret, however, Le Corbusier proposed a form that began to challenge the visual and material conventions of masonry construction. Central to this subversion of the masonry model was the attempted "de-materialization" of architecture (fig.98).

Bruno Reichlin has clearly described the various mechanisms developed by Le Corbusier to subvert the material nature of the construction.[231] The key mechanism operated at the level of composition. Rejecting the traditional conception of the envelope as a solid mass pierced by openings, Le Corbusier adopted instead a method of planar composition that gave equal status to open (windows) and closed (walls) partitions.[232] In doing so, he dramatized the condition of the modern window as a transparent portion of the taut skin that envelops interior space. The planar quality of the composition was emphasized by perceptual plays. Developing an argument first formulated by Stein Eiler Rasmussen, Reichlin clearly shows how the lintel of the large hall window of the villa La Roche appears to rest on the balustrade of the reading room, subverting the traditional perception of support elements. In the double-height hall, "the treatment of wall surfaces in the finished building was designed to emphasize the planar and elementarist as against the solid and volumetric."[233]

All the resources of the mixed construction system were exploited to generate these compositional surfaces. Masonry works were used for the production of continuous wall surfaces, erasing the distinction between load-bearing and non load-bearing walls. Reinforced concrete elements such as posts, beams, lintels were duly exploited to

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231 Reichlin (see note 44), pp. 91-108.
232 Reichlin (see note 44), p. 91.
233 Benton (see note 132), p. 61.

facilitate the making of these planar partitions. In spite of differences in the technique of implementation (casting vs layering), the two systems were united by the common nature of the material employed, cement. The impression of material continuity was emphasized by means of a uniform coating both inside and out.[234] The elementarist quality of the planes was emphasized by the absence of traditional elements of tectonic expression. Pilasters or columns that signal the transmission of loads, lintels that signal the presence of vertical weight, brackets that signal points of structural tension, were absent or concealed within the abstract wall surfaces. The treatment of isolated architectural elements further enhanced this impression of de-materialization: for instance the two cantilevered balconies that projected out from the gallery space into the double-height hall, and the long ribbon windows placed high under the roof slab on both sides of the gallery. The structural posts that supported the roof of the gallery were de-emphasized, heightening the impression of a hovering slab. The double villa was not devoid of tectonic manifestations. The pilotis that lifted the gallery space was a timid but powerful sign of structural expression. But these isolated elements merely served to underscore the a-tectonic and abstract character of the construction.

Le Corbusier's aesthetic intention was confirmed by the photographs of the villa La Roche published in L'Architecture Vivante in 1926. These photographs contrasted the image of the building under construction with views of the completed project.[235] Contradicting the conception of an ideal modernist frame based on repetition and regularity, these images showed that the posts of the structural skeleton were irregularly distributed according to the various infill and load-bearing partitions. These images testified to the heterogeneity of the construction. But Le Corbusier did not try to hide or conceal this fact. On the contrary, the publication of these images helped reveal the new

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234 The tender by Kuntz & Pigeard specifies that *lithogène* was to be used for the garden (back) facade, while a coating of cement and lime water was to be used for the street facade and lateral party walls. The adoption of a cement coating might indicate Le Corbusier's desire to increase the abstract quality of the wall, a quality that could well have been hampered by the grainy texture of *lithogène*.

235 "Hôtel particulier, rue du Docteur-Blanche, par Le Corbusier et P. Jeanneret", L'Architecture Vivante, vol. 4, no. 13, Fall 1926, plates no. 14-18. The photographs were published on two consecutive pages.

function of the modern wall. With the uniform coating applied to the heterogeneous masonry walls, Le Corbusier consciously erased the visual traces of the construction, but only to render more legible the compositional and aesthetic function of the modern wall.[236]

In a study on the relation between Le Corbusier and De Stijl, Reichlin convincingly argues that the final design of the villa La Roche-Jeanneret must be understood in light of the impact of the de Stijl exhibition presented at the Galerie l'Effort Moderne in November 1923.[237] Le Corbusier's transformation of the wall as a planar surface, and the corollary search for the de-materialization of architecture, was undoubtedly influenced by the examples of weightless planar compositions provided by van Doesburg and van Eesteren's *contre-constructions*. This affirmation of the wall as plane contrasted with contemporary discussions on the expression of construction. As Reichlin correctly notes, Le Corbusier's critique of structural expression was not new, for it was phrased in the pages of L'Esprit Nouveau as early as 1921.[238] But De Stijl would have provided both the impetus and the compositional tools to engage in this process of de-materialization. In the villa Besnus, the material signs of the constructional system were hidden, but the visible thickness of the walls remained. With the villa La Roche-Jeanneret, Le Corbusier attempted to change both the definition and the appearance of the wall. Following the examples provided by De Stijl, he clearly inflected his mode of composition, accentuating the abstract quality of the wall. In this project, Le Corbusier exploited the possibilities of reinforced concrete to begin subvert the conventions of masonry construction.

Though important, Le Corbusier's absorption of the compositional principles formulated by De Stijl was only a step in his exploration of the possibilities of the reinforced-concrete frame. And though Le Corbusier's critique of structural expression

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236 On the issue of coating as concealment, see chapter VI.

237 Reichlin (see note 44).

238 Le Corbusier wrote: "Pardon ! Accuser la construction, c'est bien pour un élève des Arts et Métiers qui tient à faire preuve de ses mérites. Le bon Dieu a bien accusé les poignets et les chevilles, mais il y a le reste." Le Corbusier-Saugnier, "Des yeux qui ne voient pas... II. Les Avions", L'Esprit Nouveau, no. 9, June 1921.

coincided with van Doesburg's, his conception of the new architecture remained focused on the "architectural treatment" of the modern frame. In fact, one of the key developments in Le Corbusier's domestic architecture after 1925 was precisely the attempt to qualify the separation between the structural frame and the wall envelope, between the skeleton and the skin.

The first instance of this architectural research was in the conception and construction of the maison Planeix in Paris (1924-28) (fig.99). Commissioned in 1924, the house was completed only in 1928. Following the first and second projects, done in 1925 and 1926, the structure (*gros oeuvre*) was completed in 1926, but changes made to the original project in 1927 triggered a second phase of construction completed in 1928. Though built on an urban site, the house's entire conception was to derive from the structural and dimensional potential of its reinforced-concrete frame. In his first study, Le Corbusier lifted the whole house upon a centralized regular grid of pilotis. The width of the lot (12 meters) induced an articulation based on three bays of 4 meters each.[239] Leaving the ground floor open, the pilotis enabled Le Corbusier to resolve the problem posed by the sloping site. In subsequent projects, the pilotis were moved to accommodate changes in plan and program. In the final project, the pilotis were integrated within the ground floor, which was ultimately turned into livable space.

The second instance of this architectural research was in the conception of the maison Cook (1925-27) in Boulogne-sur-Seine (fig.100). The entire realization process was very quick. With the brief formulated only at the end of April 1926, the construction began in July 1926 and the house was occupied in March 1927.[240] Built on an urban site, the maison Cook was based on a mixed construction system. The reinforced-concrete floors and roof terrace were supported by lateral property walls made of traditional masonry. Because of the long span between these lateral walls (10 meters), the structure required a central support. Le Corbusier adopted a symmetrical articulation of

[239] Benton (see note 132), p. 129.
[240] On the maison Cook, see Benton (see note 132), pp. 154-163.

two 5-meter spans. The load was supported by a row of reinforced-concrete pilotis on the ground floor and by posts on the other floors. The concrete pilotis permitted the opening of the house at ground-floor level, emphasizing the separation between the house and the ground. The posts on the second and third floors of the garden side were set back from the facade, emphasizing the function of the wall as an envelope. At ground-floor level, only one post was isolated from the central partition wall, while the two others were partly absorbed within it. The ground-floor pilotis thus became a figure of the separation between structure and envelope, announcing the separation of posts and partitions at the other levels. Exploiting the potential of the concrete frame, Le Corbusier further subverted two conventions of masonry construction: the load-bearing function of the wall and the rooting of the house to the ground.

The Weissenhof houses and the subversion of the masonry model

In early 1925, Le Corbusier implied that the "plastic system of reinforced concrete" had not yet been found.[241] By 1927, however, he was ready to offer a first synthesis of his search, a systematized set of principles that came to be known as the "Five Points for a New Architecture".[242] The Five Points were first formulated in the context of the Weissenhof exhibition held in Stuttgart in the summer of 1927. They first appeared in German in the booklet on Le Corbusier's Weissenhof houses written by Alfred Roth.[243] The original version of the Five Points was written in French, and dated 24 July 1927.[244] In the French version, the Five Points read: 1. *Les pilotis*, 2. *Les toits-jardins*, 3. *Le plan libre*, 4. *La fenêtre en longueur*, 5. *La facade libre*.[245] The Five Points were

241 Le Corbusier (see note 113).

242 "Les 5 Points d'une architecture nouvelle" in Le Corbusier, Pierre Jeanneret (see note 15), pp. 128-129.

243 Alfred Roth, Zwei Wohnhäuser von Le Corbusier und Pierre Jeanneret, Stuttgart, Wedekind & Co., 1927. The booklet was commissioned by the firm Akademischer Verlag sometime in July 1927. See Karin Kirsch, The Weissenhofsiedlung, New York, Rizzoli, 1989, p. 107.

244 For the original French version, see Werner Oechslin, "Les Cinq Points d'une Architecture Nouvelle", Assemblage, no. 4, October 1987, pp. 83-93.

245 The German version of the Five Points published by Roth read: 1. Die Pfosten, 2. Die Dachgärten, 3. Die freie Grundrißgestaltung, 4. Das Langfenster, 5. Die freie Fassadengestaltung.

subsequently published in Die Form, the journal of the Werkbund, and in Bau und Wohnung, the official catalogue of the Weissenhof exhibition.[246] The Five Points -- and the exhibition houses they described --are central to the understanding of Le Corbusier's conception of the frame and the aesthetic of reinforced-concrete construction.

At the end of the summer of 1927, Le Corbusier had completed the execution of two houses on the site of the Weissenhof exhibition. Organized by the Deutscher Werkbund, this exhibition was the first international manifestation of the new architecture based on executed projects.[247] The exhibition displayed various housing types: single-family houses, apartment buildings, and row houses designed by a number of European architects. Invited by Mies van der Rohe in November 1926, Le Corbusier submitted his first project the 15th of December.[248] Le Corbusier was originally commissioned to build two single houses, but problems related to execution costs led him to make important changes to the program of one house, turning it into a double house.[249] Two houses were finally built: a single-family house and a double house.

Most studies of Le Corbusier's Weissenhof contribution have recurrently sustained that the two houses derived from the two basic models developed by the architect. The single-family house is associated with the maison Citrohan, understood as a spatially defined house type. The double house is associated with the maison Dom-ino, understood as a system of structure. According to Reichlin, "Citrohan and Dom-ino, together, assume the main part of a search for the element types of the new architecture that Le Corbusier had brought forward since 1914."[250] He adds: "The Dom-ino is the

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[246] Le Corbusier, "Fünf Punkte zu einer neuen Architektur," Die Form, vol. 2, no. 9, 1927; Bau und Wohnung, Stuttgart, Wedekind & Co., 1927.
[247] On the Weissenhof exhibition see Pommer, Otto (see note 198).
[248] Pommer, Otto (see note 198), p. 83.
[249] For a discussion of the changes, see Karin Kirsch, The Weissenhofsiedlung, New York, Rizzoli, 1989.
[250] Bruno Reichlin, "The single-family dwelling of Le Corbusier and Pierre Jeanneret at the Weissenhof", In the Footsteps of Le Corbusier, New York, Rizzoli, 1991, pp. 37-57. This essay is a shorter version of the German article: "Das einfamilienhaus von Le Corbusier und Pierre Jeanneret auf dem Weissenhof, eine Strukturanalyse," Fünf Punkte in der Architekturgeschichte, ed. by K. Medici-Hall, Basel-Boston-Stuttgart, Birkhäuser Verlag, 1985, pp. 150-187.

presupposition from which Le Corbusier would define the revolution of modern architecture triggered by the use of new construction methods."[251] In his study on the Weissenhof exhibition, Pommer also argues that the double house was derived from Le Corbusier's Dom-ino house of 1914.[252] Pommer adds: "The five points -- pilotis, roof garden, free plan, ribbon window, and free facade -- constituted the rules by which the bare frame of the Dom-ino House could be turned into the completed form of the Citrohan."[253] According to Reichlin, the connection between the Weissenhof houses and the Citrohan and Dom-ino types was confirmed by Le Corbusier himself. Le Corbusier's annotations found on the back of the Weissenhof program folio read: "1 Citrohan, 1 Dom-ino".[254]

The key assumption of Reichlin's and Pommer's interpretation is the continuity between the Dom-ino frame and the building experiences of the late 1920s, a continuity in Le Corbusier's conception of reinforced-concrete construction extending from the paradigmatic frame of the maison Dom-ino to the pragmatic frames of the Weissenhof. Yet it is my contention that Le Corbusier's technical conception of the concrete frame changed during the 1920s, and that by the end of the 1920s Le Corbusier's interest in the concrete frame had shifted from the issue of production to the definition of its role in the aesthetic of the modern house.

In his early theoretical projects for mass housing, Le Corbusier demonstrated a concern for frame production, exploring the idea of structural prefabrication. The experience of Lège and Pessac encouraged a change of focus. Shifting from the vertical to the horizontal datum, Le Corbusier turned to the prefabrication of floor elements (joists), an interest potentially attributable to his working relationship with the entrepreneur Summer. Whether produced at the factory or at the building site, horizontal

251 Reichlin (see note 250), p. 38.
252 Pommer, Otto (see note 198), p. 86.
253 Pommer, Otto (see note 198), p. 87.
254 Reichlin, Otto (see note 250), p. 38.

elements became the focus of Le Corbusier's research in reinforced-concrete prefabrication.[255] In the houses of the mid 1920s -- from the villa Besnus (1923) to the maison Cook (1926) -- the concrete frames were poured *in situ*, the technique of prefabrication being exploited only for the production of floor joists. Yet in the course of the research that led from the villa Besnus to the maison Cook, Le Corbusier refined his conception of the concrete frame as the generator of new architectural principles (free plan, free facade, strip window).

The Weissenhof houses gave Le Corbusier the occasion to actualize his conception of the reinforced-concrete frame. In the booklet published during the exhibition, Alfred Roth -- the young Swiss architect who supervised the execution of the projects -- provided a good description of the frames of the two Weissenhof houses (fig.101).[256] Derived from the Citrohan type, the single-family house was based on a full-fledged autonomous frame constituted by vertical posts that went from the foundations to the top of the house. The skeleton was completed by horizontal beams that connected with the vertical posts or pilotis. Though concealed within the floor thickness, the beams 25 cm thick maintained the autonomy of the frame. Roth's description and drawings clearly distinguished between two types of vertical support: the normal post (*normaler Pfosten*), and the free post (*freier Pfosten*) or pilotis (fig.102). The normal posts are square, and concealed within the wall thickness. By contrast, the round pilotis stand as independent structural elements detached from the body of the house; used at ground-floor level, the pilotis lifted the house from the ground. According to Roth, the round shape of the free posts had optical and practical qualities.[257] Rising from the ground to the top of the house, the posts thus received a differential treatment according to their position and function within the architectural body. The distinction here between exposed and concealed posts -- already attempted in the maison Cook -- is indicative of a change in the

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255 See the advertisement for the factory-made "Siegwart beam" in Almanach (see note 217), p. 192.
256 Roth (see note 243).
257 Roth wrote: "Angenehmere optische und praktische Körperform". Roth (see note 243), p. 11.

conception of the frame. The vertical elements of the early Citrohan house were undifferentiated and repeatable, whereas the vertical elements of the Weissenhof frame are distinctive and articulated. The frame acquires a new status: it becomes an expressive element in the architectural system.

Derived from the model of the Dom-ino frame, the double house was also based on an independent structural skeleton, with posts rising from the foundation to the top of the house. But the description and drawings provided by Roth also indicate important divergences from the Dom-ino model. On the long side, the posts were connected with beams that ran along the floors. On the short side, the floor slab with concrete joists provided the necessary rigidity. The posts of the front elevation were set-back from the facades rather than incorporated into the wall, turning them into isolated pilotis. At the level of living spaces, the set back of the columns allowed for the installation of the strip window. The wall infill and lintels above the strip windows were suspended to the longitudinal floor beams by a special system of armatures. While the posts of the back elevation were in reinforced concrete, the pilotis of the front elevation were made of iron.[258] According to Pommer, the changes to the plan of the double villa occasioned a change in the structure: "The early project, like the small house, had been conceived for a concrete frame with round columns. But now the columns in the front were made of iron shaped like brackets with a gap between them to hold the sliding partitions at night without the need for floor railings".[259] This display of metal structure was unusual in Le Corbusier's work up to 1927. It betrayed his current interest in the *maison à sec* and the possibilities offered by the metal frame.[260] It also announced the abandonment of the ideal of homogeneity and monolithism he tried to achieve with the Dom-ino frame.

The new status of the frame is further reflected in Le Corbusier's current approach to industrialization. At the Weissenhof, the frames were standardized, not prefabricated.

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[258] The pilotis are described as "eisen" or "fer" in most documents. Pommer, Otto (see note 198), p. 227.
[259] Pommer, Otto (see note 198), p. 84.
[260] For Le Corbusier's research on the metal frame, see chapter VI.

Standardization itself was more and more perceived in terms of architectural composition, not building production, as is indicated by the explanation given regarding the dimensions of the frame.[261] According to Roth, the dimensions of the single-family house frame -- with spans of 5 and 2.5 meters -- derived from the dimensions of the window frame. He wrote: "The distances between the posts are given from the beginning. They are determined by the use of the sliding-window element."[262] The standardized dimensions of the Weissenhof frame were identical to those defined during the construction of the Lège houses in 1924. As Taylor explained, the standard dimensions of the house frames at Lège were arrived at only after some adjustments were made during experimentation with the cement gun.[263] At Lège, it is only after the dimensions of the frame were set that the sizes of the window elements came to be defined. But in 1927, Roth -- and Le Corbusier -- now insisted on the precedence of the window frame as an element of measure, re-interpreting the process that led to the definition of the standard frame.

At the time of the Weissenhof, Le Corbusier's interest in the application of the industrial model had clearly shifted from the production of the frame to the production of architectural elements. His attention was then turned toward the fabrication of standardized, industrially produced windows.[264] In 1926, Le Corbusier patented a window frame with a sliding horizontal opening.[265] According to the description attached to the patent, the frame could be built in wood or iron. In June 1927, Le Corbusier asked his legal representatives "to send off the documentation for the patent to be deposited in

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261 See Reichlin's analysis of the composition of the single-family house based on the window module. Reichlin (see note 250), pp. 40 ff.

262 Roth (see note 243), p. 10: "Die Pfostenabstände sind von vornherein gegeben. Sie richten sich nach der Verwendung des Schiebefensterelementes." The window elements were 2.5 m long and 1.1 m high.

263 Taylor writes: "It was at that time [July 1924], in response to technical difficulties of working with the cement-gun, that the standardized beam lengths of 5 meters and 2.50 meters were adopted." Taylor (see note 43), p. 11

264 See Le Corbusier, "Appel aux industriels", Almanach (see note 217), pp. 102-103.

265 "Chassis de fenêtre à coulissement horizontal" Patent no. 619 254, registered 23 July 1926. See Dario Matteoni, "The 16 Patents of Le Corbusier 1918-1961", Rassegna, no. 46, June 1991, p. 77.

Germany".[266] Though the window frames of the Weissenhof houses were hand-made and executed in wood, they offered a clear demonstration of Le Corbusier's vision of the industrialization of housing. The patented window frame was even presented in a stand at the Weissenhof exhibition of materials and construction techniques held in conjunction with the housing exhibition. Le Corbusier's argument positing the dimensional precedence of the window opening must be understood in light of the shift from the structural frame to the window frame as the privileged element for the industrialization of the house. At Lège and Pessac, the frame was still conceived as the dimensional determinant. At the Weissenhof, the constructional standard (the frame) was seriously challenged by the compositional standard (the window).

In a perceptive analysis of the Weissenhof houses, Reichlin argues that "Le Corbusier constructs modern architecture's new vocabulary out of a kind of subtle inversion of traditional architecture".[267] This subtle inversion was embedded in the very definition of the Five Points. He underlines that "the *toit-jardin* is the negation of the traditional pitched roof," that the *plan libre* subverts the ancestral plan of the house, and also that the "*fenêtre en longueur* and the *pan de verre* are finally the oppositional terms of the traditional vertical window, also called the window *à la française*."

This subtle inversion of traditional architecture -- associated in France with masonry construction -- was most obvious in the development of the structural pilotis. Beyond its structural function, the pilotis operated at the level of architectural perception. The pilotis was characterized by its lightness and linearity, yet the structural function it performed was related to weight and strength. The pilotis tied the house to the ground, yet also elevated it from the ground. As such, it had the power to generate ambiguous perceptions, something well noted by contemporary writers. Commenting on the pilotis of Le Corbusier's Weissenhof houses, the critic René Huyghe underlined the contrast,

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266 Matteoni (see note 265), p. 77.
267 Reichlin (see note 250), p. 56.

not to say contradiction, between the weight of the cubic forms and the fragile character of the pilotis.[268] Used in the modern house, the concrete pilotis became a visual marker that materialized the idea of structural skeleton, a visual marker that consecrated the subversion of the masonry model.

Conclusion

The development of modern architecture in France was intimately related to the architecture of the modern house. By 1924, the formal characteristics of the new architecture had been enshrined in the type of the undecorated cubic house in reinforced concrete. This formal definition was largely the result of projects presented, in drawings and architectural models, at the various architectural exhibitions held between 1922 and 1924. It was further enhanced by a reading of the new architecture in light of the contemporary critical discourse on cubism. Symptomatic of this abstraction of technique was the assimilation of the architect's building materials to the pigments of the painter, the clay of the sculptor, the *matière* of the artist, which established an ambiguous relation between the technique and the form of reinforced-concrete construction.

With the exception of Le Corbusier, French modern architects were seldom involved in the technical investigation of new materials. Focusing on the works of André Lurçat, Robert Mallet-Stevens, and Le Corbusier executed between 1924 and 1927, an examination of the relation between the construction and the form of the modern house reveals that a full-fledged autonomous concrete skeleton was seldom used, the standard structure being a mixed system that combined reinforced-concrete elements and load-bearing masonry construction. In most cases, reinforced concrete was conceived not as an alternative but as a complement to masonry construction. The partial frame was not merely the embryo of a full fledged frame, for in most instances houses with partial

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268 Huyghe wrote: "Pourquoi Le Corbusier et Jeanneret donnent-ils aux pesantes masses cubiques de la cité-jardin du Werkbund, à Stuttgart, de la ville de Boulogne ou du palais du Peuple pour L'Armée du Salut, le dérisoire support de ces pilotis, fragiles au regard ?". René Huyghe, "Le Salon d'Automne", L'Architecture, vol. 40, no. 12, December 1927, p. 402.

frames were not conceived on the basis of the frame, but rather on the basis of masonry walls. In those instances, frame elements were merely positive substitutes for masonry walls.

More important, major differences are revealed in the conception and role of the concrete frame itself. While Le Corbusier conceived the modern house with the frame in mind, Mallet-Stevens approached the frame as an alternative system to be inserted within the masonry structure. These differences are not solely technical, for they provide clues as to the conceptual process followed and concerning the sources of the aesthetic project itself. With Lurçat and Mallet-Stevens, the tectonic potential of the concrete frame developed within the realm of the stereotomic tradition. Le Corbusier, on the other hand, explored the dialectical relation between the structural and the aesthetic system, proposing a new understanding of the rapport between the frame and the wall, the frame and the plan, the frame and the elevation. With Le Corbusier, the frame was ultimately exploited to subvert the visual conventions of masonry architecture.

CHAPTER VI

PERRET, LE CORBUSIER, AND THE COMPETING PARADIGMS OF FRENCH MODERNISM (1927-29)

By the time of the first CIAM congress held at La Sarraz in June 1928, Auguste Perret and Le Corbusier had become the two main protagonists in the debate on French modernism. Actively engaged in the organization of the congress, Le Corbusier proposed an *exposé* on "the architectural consequences of modern techniques". His aim was to trigger a discussion on the impact of new structural materials in the conception and production of architecture. Though invited, Perret did not attend the CIAM congress. He had, however, attended the first Congrès International du Béton Armé held in Paris in May of that year. In a talk presented during a session on "Modern Construction and Architecture", Perret denounced the *Esthètes sans métier*, warning against the architectural whims permitted by the use of concrete. By then, Perret and Le Corbusier had come to defend two radically opposed views on materials and modernism.

By the end of the 1920s, Perret had come to defend the principles of constructional truth and material visibility, merging a Rationalist conception of structure with a Ruskinian idea of material. It is on this basis that he and his circle condemned the new French architecture for its deceptive use of concrete, fostering a cultural project opposed to the internationalism of the emerging modern movement. By contrast, Le Corbusier had come to conceive the frame as the basic generative structure of the architecture of buildings, proposing a system that merged the constructional with the formal. Synthesized in the *Five Points for a new architecture*, this system led the way to overcoming the conventions of structural Rationalism. The principles took precedence over the material itself, encouraging a shift to use of the metal frame and the realization of the *maison à sec*.

These fundamental oppositions within French modernism were obfuscated by early retrospective readings on the sources and development of modern architecture in France. The interpretation proposed by Myron Malkiel-Jirmounsky in the late 1920s is illustrative of this tendency. In two articles published in 1928, and a book published in 1930, Jirmounsky stressed the distinction between the works and ideas of Auguste Perret and Le Corbusier. Yet he proposed an analysis that veiled their diverging conception of materials and construction, focusing instead on the formal distinction between Perret's and Le Corbusier's aesthetic treatment of the concrete frame. Reiterating Perret's critique of the use of coating in modern architecture (and the corollary association of this practice with an operation of concealment of the frame), Jirmounsky yielded to the contemporary rhetoric on constructional and material truth -- and indication of the fact that by the end of the 1920s, French historiography tended to frame the debate on reinforced-concrete construction in terms of the figural, not the generative function of the structural frame.

1. Perret, French Modernism, and the Truth of Materials

> Until today, architecture had been frank and truthful.... It is unfortunately our era, though fertile and sincere, that has invented the architectural lie.[1]

It is with these words that in 1929 the critic Marie Dormoy qualified the contemporary use of reinforced concrete in French architecture. All architecture that did not visually express the reinforced concrete that was constitutive of its structure merited the title of "false concrete". For Dormoy, this deceptive practice was not limited to the eclectic approach of Beaux-Arts trained architects, but applied equally to architects involved in the new architecture. Under an illustration of the the villa Bomsel at Versailles designed by André Lurçat, she asked: "In what material is this house? In cardboard? In plaster? It is

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[1] Marie Dormoy, "Le Faux Béton", L'Amour de l'Art, vol. 10, no. 4, April 1929, p. 128: "Jusqu'à maintenant, les achitectures avaient été franches... Il a fallu que ce soit notre époque, pourtant si féconde et si sincère, qui invente le mensonge architectural." She added: "C'est cette erreur primordiale qu'il faut combattre résolument, partant du principe que l'ossature d'un bâtiment doit se voir au moins autant que se voit le squelette d'un animal."

apparently in concrete. Why is it not in iron, which could achieve the same span ?"[2] The absence of any visible sign of the agglomerate material was sufficient to deny the building its status as an architecture of concrete, an absence, according to this interpretative framework, regarded as a deliberate concealment, an architectural lie. For Dormoy, the visual expression of the structural material had become a central issue in the critique of modern houses and the definition of modernism.

Béton armé apparent

Marie Dormoy's critique of the new French architecture and its deceptive use of coating was largely indebted to Perret's own reading of the situation. Dormoy's close connection to Perret is revealed by the manuscript of about 1929 of the article "Le faux béton armé", which was carefully annotated by Auguste Perret in a way that reveals his desire to both correct and direct the interpretation of his work.[3] Most of the annotations focus on the architect's critical use of external revetments.

Commenting on the Perrets' 25bis rue Franklin and the origin of reinforced-concrete architecture in France, Dormoy wrote: "The facade has been civered with stoneware tiles in order to avoid the cost of *ravalement*".[4] Correcting the sentence, Perret wrote: "The facade has been covered with stoneware tiles in order to make it waterproof."[5] By then, Perret sought to explain the use of stoneware tiles as a technical, not a decorative choice. Writing about the rue de Ponthieu garage, Dormoy dwelt on her earlier reading of the building. In her article of 1923, the garage was "the first example of a purely practical architecture."[6] By 1925 it was deemed "the first example of the new

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[2] Dormoy (see note 1), p. 132: "En quoi est cette maison ? En carton ? En plâtre ? Elle est paraît-il en béton. Pourquoi ne serait-elle pas en pans de fer, qui permet les mêmes portées ?"
[3] Marie Dormoy, "Le faux béton armé", annotated manuscript, n.d. (c. 1929) (Fonds Perret, 535 AP 359).
[4] Dormoy (see note 3), p. 2: "La façade a été revêtue de plaques de grès afin d'éviter des frais de ravalement."
[5] Dormoy (see note 3), p. 2: "La façade a été revêtue de plaques de grès afin de la rendre étanche."
[6] Marie Dormoy, "A. et G. Perret", L'Amour de l'Art, vol. 4, no. 1, January 1923, p. 412: "le garage de la rue Ponthieu est le premier exemple d'une architecture purement pratique."

architecture, interesting for both its conception and its execution."[7] As such, Dormoy merely anticipated Paul Jamot's reading of 1926, for whom the garage was the first affirmation of the principles of reinforced-concrete architecture.[8] It is at this juncture that Perret made a decisive contribution to the interpretation of the garage. Correcting Dormoy's phrasing, Perret wrote that the garage was "the true beginning of construction in **visible** reinforced concrete."[9] Perret's correction is indicative of a change in his definition of reinforced-concrete architecture in the late 1920s. In his description of the Raincy church, Perret had earlier used the terms rough (*brut*) and naked (*nu*) to describe the concrete.[10] In his annotations of 1929, Perret opted instead for the expression *béton armé apparent*, relying upon a distinction between *apparent* and *visible* that had been already articulated in the late-nineteenth-century debate on the fate of iron architecture.[11] By the end of the 1920s, Perret's qualification of reinforced-concrete architecture had come to be profoundly tied to the issue of the material's "visibility".[12]

Perret and the "visibility of materials"

Between 1923 and 1925, Perret's critique of modern houses focused on questions of form making and the rejection of traditional architectural features such as the cornice and the tall window. His critique of Adolf Loos and Le Corbusier were formulated in the context of the Salons d'Automne. By 1927, the focus of the debate had shifted. Perret and the promoters of the *architecture du béton armé* began to draw attention to another

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[7] Marie Dormoy, "L'architecture moderne française", La Revue Française de Prague, vol. 4, no. 19, 1 July 1925, p. 163: "le garage de la rue Ponthieu restera comme le premier exemple de l'architecture nouvelle, aussi intéressant comme conception que comme réalisation."

[8] Paul Jamot, "1905. date décisive pour l'architecture du béton armé", L'Art Vivant, 1 September 1926, pp. 642-644.

[9] Dormoy (see note 3), p. 2: "Le véritable point de départ la construction de béton armé **apparent**."

[10] In a note of 1914 describing his early projects, Perret wrote: "nu - le garage (Ponthieu); revêtu de grès - rue Franklin; revêtu de marbre - le théâtre des Champs-Elysées". A. Perret, manuscript note, undated [c. 1914] (Fonds Perret, 535 AP 329).

[11] De Villenoisy argued that the French term *apparent* was more accurate than the term *visible*, since metal could be exposed without being bare, as was the case when metal was painted. François de Villenoisy, "L'architecture en fer et l'Ecole française contemporaine", Revue des Arts Décoratifs, vol. 16, 1895-1896, pp. 325-333. See chapter I.

[12] I propose to translate the French expression *apparent* by "visible", and *visible* by "exposed".

issue: the truthful use of building materials. Truth in the use of materials depended on two interrelated yet distinct conditions: the readability of the structure and the visibility of the external material.

Perret's quest for the truthful use of materials first derived from the dialectical relation between structure and infill. His insistence on this constructional duality was not new. Before the war, Perret was already arguing that reinforced-concrete construction generated an architecture based on the duality structure / infill. But until the mid 1920s, the emphasis was placed on the primacy the skeleton, not on the nature of the infill -- in 1923 Perret was quoted as saying: "Erect the skeleton and fill in the holes with whatever you want".[13] This unconcern for the nature of the infill was probably related to the war experience and motivated by the concern to achieve low-cost housing construction with limited resources. By 1926, however, Perret began to insist on the textural expression of the different materials used which were chosen for their specific qualities.[14]

The issue of material visibility was first raised by the architect Charles Imbert, one of Perret's collaborators and friends, in his review of the villa Seurat. Perret had just completed the construction of the house-studio for the sculptor Chana Orloff located on the same street (fig.103). Critical of the white facades of Lurçat's studios and villas, Imbert wrote: "In which materials is it built? We do not know. Is it built in stone, brick, reinforced concrete, we do not even see it?"[15] By contrast, Perret's studio offered a different scene to the viewer: "Here are real posts in reinforced concrete, beams, a cornice in reinforced concrete. This is all visible." He added further: "Here on the second floor, in order to show that it is only used as an infill, the brick is placed diagonally.... Here are some rubble stones on the party wall on the right. There aren't many, but these honest

[13] Dormoy (see note 6), p. 412: "Dressez l'ossature et bouchez-en les trous avec ce que vous voudrez".
[14] See Roberto Gargiani, Auguste Perret 1874-1954. Teoria e opere, Milan, Electa, 1994, p. 86
[15] Charles Imbert, "Le quartier artiste de Montsouris...", L'Architecture, vol. 40, no. 4, 15 April 1927, p. 106: "En quoi cela est-il bâti ? Nous n'en savons rien. Est-ce de la pierre, de la brique, du ciment armé, on ne le voit pas ?"

rubble stones have been carefully presented. Rubble stone is not a second-category material." [16] For Imbert, building materials had to be truthfully employed and displayed.

In opposition to the honesty and truthfulness of materials called for by Imbert was the contemporary notion of concealment. In a brief presentation of Perret's theory and practice, Louis Charvet stressed that in the rue Franklin building the reinforced concrete was "hidden" under the stoneware tiles covering the facade, but that the use of revetment and facing was abandoned with the rue de Ponthieu garage.[17] Oblivious to the rich marble facing of the Champs-Elysées theater, the reviewer interpreted the use of revetment in terms of disguise, of concealment.

The truthful exposition of building materials was soon to become a key argument in the definition of Perret's architecture and the critique of the avant-garde. This critical position was developed in a number of articles published in L'Amour de l'Art. In a long article on the architecture of Mallet-Stevens, Marie Dormoy exploited and expanded this idea. She wrote: "Though an architect, Mallet-Stevens is not really concerned with the material employed. He uses reinforced concrete because it is now the most economical, the material permitting long spans unknown until today, one that allows conceptions unthinkable only fifty years ago. But Mallet-Stevens does not 'think' reinforced concrete."[18] According to Dormoy, Mallet-Stevens approached architecture as sculpture, at a time when most architects insisted on the idea of construction and the constructional. In his work, numerous construction details were not necessary to the structure of the

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[16] Imbert (see note 15), pp. 109-110: "Voilà en effet des poteaux en ciment armé, des poutres, une corniche en ciment armé. Cela est bien apparent." He further added: "Voici à l'étage, pour montrer qu'elle n'est qu'en remplissage, de la brique, placée en diagonale... Voici même du moellon sur le mitoyen de droite. Il n'y en a pas beaucoup, mais on l'a présenté avec soin ce brave moellon, ce n'est pas un parent pauvre."

[17] Louis Charvet, "Visites d'ateliers: Les constructeurs Auguste Perret", Revue des Jeunes, 10 January 1927, pp. 54-65: "La maison de la rue Franklin dénonce encore une hésitation ou une concession: l'armature de béton se **dissimule** sous les plaques de grès qui recouvrent la façade."

[18] Marie Dormoy, "Robert Mallet-Stevens", L'Amour de l'Art, vol. 8, no. 10, Octobre 1927, pp. 373-375: "Bien qu'architecte, Mallet-Stevens s'inquiète assez peu du matériel employé. Il se sert du béton armé parce qu'en ce moment il est le plus économique, celui qui permet des portées inconnues jusqu'ici, celui qui se plie à des réalisations inconcevables il y a seulement cinquante ans. Mais Mallet-Stevens ne "pense" pas en béton armé."

building. "To affirm his conception, Mallet-Stevens conceals the material used under a coating. He uses concrete as a precious servant which bows to the fantasies of his master, but does not let itself appear."[19] For Dormoy, Mallet-Stevens' houses would have had the same aspect if the concrete posts had been replaced by iron posts. Commenting on the rue Mallet-Stevens at Auteuil, Dormoy argued that the entire project was more plastic than architectural.[20]

In a contemporary article that celebrated Perret's architecture, and criticized the works of the modernists, Marcel Mayer also exploited the argument on the truthful use of materials.[21] He argued that in the contemporary movement of opinions about architecture, two doctrines were present: the "purist" and the "classical".[22] The purists were doctrinaire and deprived of the sense of construction, their work merely able to create a fashion. By contrast, the classicists were viewed as authentic builders, producing works which renewed their art while pursuing its most proven traditions. For Mayer, the opposition between the purists and the classicists was -- and fundamentally -- an opposition between romanticism and classicism. The romantics and the classicists shared the same building material, in the same way that Hugo and Delacroix shared with Bossuet and Watteau the same French syntax and the same colors.[23] It was only because of the exceptional quality of reinforced concrete that the architecture of the romantics could stand up. "But", Mayer wrote, "true architectural beauty is so foreign to the romantics that they conceal without remorse one of the most beautiful organs of construction under

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[19] Dormoy (see note 18), p. 375: "Pour affirmer jusqu'au bout sa conception, Mallet-Stevens dissimule même le matériel employé sous un enduit. Il se sert du béton comme d'un précieux serviteur qui sait se plier à toutes les fantaisies de son maître, mais il ne se laisse pas apparaître."

[20] Dormoy (see note 18), p. 378: "Bien plus qu'architectural, cet ensemble a un aspect plastique".

[21] Marcel Mayer, "L'architecture du béton armé. Les romantiques", L'Amour de l'Art, vol. 9, no. 3, March 1928, pp. 81-87.

[22] Mayer (see note 21), p. 81.

[23] Mayer (see note 21), p. 84: "Si Hugo et Delacroix furent contraints d'utiliser la même syntaxe que Bossuet ou les mêmes couleurs que Watteau, nos néo-romantiques ont, eux, un matériau nouveau: c'est lui qui les sauve, et ils s'en servent avec honte."

a coating or a roughcast covering."[24] Extending his anatomical analogy, he argued that the romantics were concerned merely by the skin, not the structure and the muscles of the built organism, "And thus disappear the loyal and honest materials which are to the architect what colors are to the painter."[25] This analogy between building and artistic materials was current among Beaux-Arts trained architects.[26] In the preface to Paul Augros' book on the technical and architectural possibilities offered by reinforced-concrete, the architect Louis Bonnier wrote in 1926: "The 'material' is a fundamental element of the artistic work. The painting or the fresco, the marble or the bronze, the stone or the iron profoundly modify the aesthetic expression of a similar program." [27] But for Mayer, as for Imbert, building materials could be endowed with honesty. For Mayer, the deliberate concealment of the concrete frame was a betrayal of the material's integrity, and thus, of true artistic expression.

In a following article, Mayer's defence of Perret's classicism was argued in light of the architect's rejection of coating.[28] This plea was again formulated in the context of the analysis of the Chana Orloff house-studio built in the Cité Seurat. The studio was presented as a crucial moment in Perret's career because of his "decisive and definitive repudiation of external coating."[29] If Perret had used coating in the past, Mayer stated, it was for economical reasons, and not without some aversion. In addition to the fact that coating masked the real materials, the architect's opinion was that the coating cracked

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[24] Mayer (see note 21), p. 84: "Mais la véritable beauté architecturale leur est si étrangère qu'ils dissimulent sans regrets sous des enduits ou des crépis badigeonnés l'un des plus beaux organes de la construction."
[25] Mayer (see note 21), p. 84: "Ainsi disparaîssent les probes matériaux qui sont cependant à l'architecte ce que les couleurs sont au peintre."
[26] On this analogy, see chapter V.
[27] Louis Bonnier (preface), in Paul Augros, Béton armé. Possibilités techniques et architecturales, Paris, Ch. Massin, 1926, p. 5: "Le 'matériau' est un des facteurs essentiels de l'oeuvre artistique. La toile ou la fresque, le marbre ou le bronze, la pierre ou le fer modifient profondément l'espression esthétique d'un même programme."
[28] Marcel Mayer, "L'architecture du béton armé. Une oeuvre classique", L'Amour de l'Art, vol. 9, no. 7, July 1928, pp. 267-269.
[29] Mayer (see note 28), p. 269: "ces grands architectes abandonnent les enduits extérieurs d'une façon décisive et définitive."

rapidly due to the expansion caused by weather differences and settling.[30] This rejection of coating was proof of Perret's genuine love of 'materials', and his belief that the choice, composition, and careful craftsmanship of materials could generate beauty.

Perret and the critique of coating

This new attention to the visibility of building materials was defended by Auguste Perret himself. In May 1928, Perret attended the first Congrès International du Béton Armé. Held in Paris, the congress organized by the Chambre Syndicale des Entrepreneurs de Maçonnerie, Ciment, et Béton Armé was attended by representatives of twelve nations.[31] In a talk delivered during the session on "Modern Construction and Architecture", Perret denounced the architectural whims of the *esthètes sans métier,* making a veiled reference to Le Corbusier and the like. But the crux of his declaration pertained to his new attitude towards building materials: "Let us wish that reinforced concrete always be left visible, molded to perfection or altered with the appropriate tools. Whenever possible, let us try not to conceal any essential organ of the construction like posts and beams.... Let us wish that the numerous materials, natural and artificial, that can be used to fill the structural skeleton be also left visible on the outside, without any coating."[32]

Perret's congress statement can be taken as the official formulation of a doctrinal position that was articulated between 1926 and 1928.[33] It required a critical revision of

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[30] Mayer wrote: "Ces quelques expériences les ont d'ailleurs confirmés dans cette juste opinion que l'enduit, outre qu'il masque les véritables matériaux, se fissure rapidement sous l'action du jeu des dilatations et retraits provoqués par les différences de température et par les tassements." Mayer (see note 28), p. 269.

[31] See Compte-rendu général du Congrès Technique International de la Maçonnerie et du Béton armé, Paris, May 1928.

[32] Auguste Perret, "Note sur l'architecture", in Compte-rendu général (see note 31), Section IX, p. 3: "Souhaitons que le Béton de ciment armé soit toujours laissé apparent, moulé à la perfection ou repris à l'outil. Qu'autant que possible, jamais un organe essentiel: poteau, poutre, ne soit dissimulé; (...). Souhaitons, en outre, que les innombrables matériaux, naturels et artificiels, qui peuvent servir à clôturer l'ossature, à l'extérieur, soient également laissés apparents, à l'exclusion de tout enduit."

[33] Perret confirmed and developed this position in later publications: Auguste Perret, "Vers un style nouveau en architecture. Construisons avec des matériaux apparents... nous dit M. Auguste Perret", L'Intransigeant, 21 June 1930. See also Perret's lecture given in Amsterdam, 3 February 1931 (Fonds Perret, 535 AP 328). Excerpt of the lecture was published as "Architecture: Science et Poésie", La Construction Moderne, vol. 48, 2 October 1932, pp. 2-3.

Perret's own building practice of the post-war period. Beginning with his project for the *maisons en série* published in the December 1921 issue of L'Esprit Nouveau, Perret envisioned the use of a cement-based coating on the external wall surfaces of the building. In the houses designed between 1922 and 1925 -- the Gaut house in Paris, the worker housing at Grand Quévilly near Rouan, the Mouron house at Versailles -- Perret was to make use of the coating technique. In the case of the Gaut house, Perret mixed color within the coating, giving to the external wall surfaces the appearance of stone.[34]

In a manuscript note on the house-studios designed between 1926 and 1928, Perret explained his rejection of coating, reaffirming the importance of the dualism of structure and infill:

> These houses are built with posts in visible reinforced concrete; their architecture is governed by their reinforced-concrete skeletons, visible or expressed by means of the revetment. Our effort has been to make the program of the clients fit within a structural skeleton that is ordered, well-balanced, even symmetrical, and worthy of being shown naked or enriched by a revetment that is more precious than concrete. One should not consent to employ the constructional strength of reinforced concrete, and then conceal it to realize fantasies dictated by fashion, dictated by formulas.... In these houses, we did not want to take the easy solution provided by the use of coatings, and in both interiors and exteriors we have tried to leave the construction materials used for the skeleton and the infill visible.[35]

The visibility of materials, and the corollary critique of coating, were also the key issues discussed in an unpublished article on Perret's house-studios written by Marie Dormoy.[36] Focusing on the Chana Orloff house (1926-27) and the Bressy hotel (1927-28), both built in Paris, Dormoy stressed that these buildings respected Perret's principle

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[34] For a discussion on Perret's use of coating, see Gargiani (see note 14), p. 189.

[35] [A. Perret], "Chana Orloff - G. Aghion - G. Braque - F. Cocea Bressy", manuscript, undated [c. 1928], pp. 1-2 (Fonds Perret, 535 AP 329): "Ces maisons sont construites en pans de béton armé apparent; ce sont les Ossatures en béton armé, apparentes ou accusées par le revêtement, qui en ordonnent l'Architecture. Notre effort fut, après avoir, par des distributions et des dispositions appropriées, donné satisfaction aux programmes de nos clients, de faire tenir ces dispositions dans une Ossature ordonnée, équilibrée, *symétrique même*, digne d'être montrée *nue*, ou enrichie d'un revêtement en matériaux plus précieux que le Béton. Il ne faut pas consentir à employer le puissant moyen de construction qu'est le béton armé, pour, en le dissimulant, réaliser les fantaisies d'une mode, les exigences d'une formule.... Nous n'avons pas voulu dans ces maisons nous laisser aller aux facilités que donnent les enduits et tant pour les extérieurs que pour les intérieurs, nous nous sommes efforcés de laisser les matériaux de construction apparents, aussi bien pour les Ossatures que pour les remplissages."

[36] Marie Dormoy, untitled unpublished manuscript, undated [c. 1927] (Fonds Perret, 535 AP 359). The manuscript was annotated by Auguste Perret.

of frank construction: the skeleton always appeared clearly.[37] On the Orloff house-studio, Dormoy wrote that right from the facade the house struck the viewer because of its reinforced-concrete "character".[38] Right from the outset one could see the 'skeleton' of the construction, indicated by the posts in bare, visible reinforced concrete: "These concrete posts are bush-hammered, giving them the aspect of a finished material."[39] On the Bressy hotel, Dormoy explained that since the owners of the residence did not want visible concrete, Perret chose to clad the facade with a stone revetment made of thin slabs that covered the construction without concealing it.[40]

Perret's annotation of Dormoy's description of the Mouron house at Versailles (1924-26) (fig. 104) and the Véret house at Noyon (1926) gives evidence of the architect's desire to clarify a fundamental point of his position.[41] Dormoy wrote that the two houses, built with the same concrete frame system [*ossature*], had been recovered with a stone-colored coating [*enduit couleur pierre*] that left the skeleton visible.[42] Perret crossed out the terms "skeleton" and "stone colored coating ". He wrote: "built without a skeleton, the reinforced-concrete floor slabs are supported by brick walls. There are no posts in the walls of the facade, otherwise we wouldn't have made use of coating."[43] In place of the expression "stone colored coating", Perret wrote "slaked lime mortar" [*mortier de chaux*]. Dormoy had further written that since coatings had not achieved the needed quality and did not weather well, the Perrets quickly abandoned them quickly. Bracketing the first part of the sentence, Perret added that coatings would never reach the

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37 Dormoy (see note 36), p. 3.
38 Dormoy (see note 36), p. 3: "Dès la façade, elle nous frappe par son caractère "béton armé".
39 Dormoy (see note 36), p. 3: "Ces poteaux sont du reste bouchardés, ce qui leur donne un aspect de matériel définitif."
40 Dormoy (see note 36), p. 5.
41 The Perret Archive does not contain any drawings or documentary trace of the project for the Véret house at Noyon. In A.-G. Perret et l'architecture du béton armé (1927), Paul Jamot gives 1926 as the completion date of the maison Véret.
42 Dormoy (see note 36), p. 6.
43 Dormoy (see note 36), p. 6: "construites *sans ossature, ce sont des murs en briques qui supportent des dalles en béton, il n'y a pas de poteaux dans les murs de façade, sans quoi on aurait pas usé de l'enduit.*"

necessary level of quality, that the phenomenon of expansion would always prevent their use.

Perret's critique of coating indicates a broader change regarding his evaluation of building materials in modern architecture. During the first half of the 1920s, the use of coating was common among the architects associated with the new architecture. His annotations reveal that by 1928, he was trying both to defend his previous use of coating and to justify his current rejection of it on the basis of a technical argument. His earlier use of coating was justified on the basis of the nature of the houses' structures, denying any influence of a purist and cubist aesthetic on his work.[44] Reporting Perret's opinion in his article of 1928, Mayer did not hesitate to link the technical with the aesthetic.[45] Outside the technical argument, Perret's rejection of coating was thus fundamentally doctrinal.

By 1926, Perret abandoned the use of coating altogether, reverting instead to visible brick infills, commonly used in Perret's industrial architecture. In the house-studio for Chana Orloff (1926-27), the house-studio for Georges Braque (1927) (fig.105), the house-studio for Mela Muter (1927-28), it was the shapes and patterns of the brick masonry that gave the wall a dual status as both protective infill and decorative revetment. Patterned brick infills also came to be used in religious buildings, such as in the chapel at Arcueil (1927-28) and the chapel of the Couvent des Frères mineurs at Tours (1930). By 1926, Perret's approach to the relation between structure and infill had thus taken a new turn. Until then, the aesthetic of reinforced-concrete architecture had focused on the qualification of the structure. By 1926, it was the nature and appearance of the infill that was to be the new focus of attention.

On the nature of revetment materials

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44 In 1932, Perret went further, stressing that even his early use of coating was ill-advised from the technical point of view. See Auguste Perret in L'Architecture d'Aujourd'hui, (special issue on Perret) vol. 3, no. 7, 1932, p. 39.
45 Mayer (see note 28).

Perret's new interest in the nature of the revetment was not limited to small-scale projects. Larger-scale projects were to offer the basis for the full development of this approach. Perret's entry for the Palace of the Société des Nations competition (1927) is a case in point. In his description of the projected building, Perret wrote: "The construction of the building is made of a reinforced-concrete skeleton and a wall infill. The wall infill is made of a double layer of bricks with a hard stone or marble revetment on the outside."[46] For this important public building, Perret envisioned use of a stone or marble revetment. Perret further described the wall infill: "The infill of the skeleton is based on a double-layer wall for all the facades." The internal wall layer was to be made of hollow bricks 11 cm thick, the external wall with solid bricks 11 cm thick. The stone or marble revetment was to be executed at the same time as the double brick wall to secure the quality of embedding and attachment. Perret further differentiated the revetment thickness: the revetment attached to the skeleton was to be 11 cm thick, while the revetment of the infill was to be 4 cm thick.

Perret's specifications regarding the internal revetment suggest the very broad definition given to the idea of material visibility. In most rooms, the internal finish was to be made of a plaster coating, but in a number of representational spaces -- such as the entrances, the peristyle, and the *salles des pas perdus* -- the finish was to be made of stone-colored stucco. In the large hall, all the posts, beams and ribs were to be covered with stone-colored stucco, while the infill and balustrade of the balcony were to be revested with marble. Finally, the dome of the large hall was to be in visible bush-hammered concrete, because, Perret noted, being at close range it could be viewed by the public.[47] For Perret, the nature and quality of revetment materials depended on the status

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[46] Auguste Perret, "Description sommaire", unpublished manuscript, undated (Fonds Perret, 535 AP 317): "La Construction du Bâtiment se compose d'une ossature en béton de Ciment armé et d'un remplissage à double paroi en brique avec à l'extérieur un revêtement en pierre dure ou en marbre."
[47] Perret (see note 46): "Le dôme couvrant la Grande Salle étant donné la distance de laquelle il est vu est traité en béton apparent bouchardé."

of the building type. While brick was used for small-scale housing projects, stone or marble could be envisioned for large-scale, public buildings.

On visible concrete as revetment

During the second half of the 1920s, Perret began to explore the expressive possibilities of concrete itself.[48] These developments were obtained by means of a judicious choice of inert materials, and also by using different treatment processes for the concrete after removal of the forms.[49] Perret was not the only one to explore the texturing of concrete. By the mid 1920s, François Le Coeur had set a well-known precedent. In the Central téléphonique 106-108 rue du Temple in Paris (1920-26), the Hôtel des Postes in Reims (1924-27), Le Coeur had exploited the possibilities of rough and modeled cement and worked on the distinction between the structural frame and the infill by means of variations in textures and colors.[50]

Moving away from the *béton brut* of the early 1920s (Raincy church, Grenoble tower), Perret began to exploit the technique of bush-hammered concrete. Bush-hammering was a masonry technique applied for finishing roughly quarried stone. Perret transferred the technique from masonry to concrete construction. Applied to the treatment of rough concrete surfaces, this technique involved hand-work and a good level of craftsmanship (fig.106). Perret's adoption of the bush-hammering technique enabled him "to discriminate between the exposed aggregate of the *in situ* skeleton and the latex smoothness of the pre-cast element".[51] Perret consistently drew a distinction between *in situ* and pre-cast concrete, distinctions probably found necessary to distinguish between the two types of function performed.[52] For while the concrete poured *in situ* was

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48 On this issue, see Gargiani (see note 14), pp. 192 ff.
49 The exposed concrete skeleton of the house-studio Chana Orloff indicates the new attention paid to the granular quality of the inert material.
50 On Le Coeur, see Gargiani (see note 14), p. 193.
51 Kenneth Frampton, "Auguste Perret and Classical Rationalism", Studies in Tectonic Culture (ed. by John Cava), Cambridge-London, The MIT Press, 1995, p. 143.
52 According to Frampton, this distinction is reminiscent of the play between cast and wrought iron in the work of Viollet-le-Duc. Frampton (see note 51), p. 143.

structural, the pre-cast concrete was used solely as revetment. By the end of the 1920s, Perret's conception of the truthful use of materials thus relied on the employment of techniques that aimed at transforming the surface of the concrete material itself.

Central to Perret's new approach was this use of pre-cast concrete elements for the infill. The technique he developed was a system of pre-cast concrete panels attached to the wall infill. The concrete slabs were attached between them to the main structure by means of a metallic armature. Perret used this new technique for a number of *hôtels particuliers* built at the end of the 1920s such as the villa Arakel Nubar Bey at Garches (1930-32) and the villa Neveu at Saint-Cloud (1930). The pre-cast concrete panels were conceived as a protective infill, yet their real status was ambiguous. Evoking the texture of reconstituted stone, these concrete slabs could also be read as a decorative stone revetment. The pre-cast concrete panels acquired the dual status of protective infill and decorative revetment.

Even before these *hôtels particuliers*, however, Perret had first used the technique of pre-cast panels in two larger-scale projects: the immeuble 51-55 rue Raynouard in Passy (1928-30), and the headquarters of the Service Technique des Constructions Navales in Paris (1928-31). In the rue Raynouard building, the composition of the facade derived from the play between the structure and the infill (fig.107). The slight projection of the structural elements, emphasizing the contrast of shadow and light, made the pattern of the skeleton stand out clearly.[53] The relief of the structure, together with the recess of the infill, graphically illustrated that the envelope did not have the value of a load-bearing wall. The texture and color of the concrete further distinguished between the infill and the structure, since the color of the infill slabs was lighter than that of the structural elements (pilasters, architrave, jambs, and cornices).

At the headquarters of the Service Technique des Constructions Navales, Perret adopted the same system of pre-cast concrete panels (fig.108). But the distinction in

[53] Gargiani (see note 14), p. 194. As I discuss below, the concrete skeleton that appears on the facade of the rue Raynouard building is merely a figuration of the actual structural system.

terms of the color and texture of concrete surfaces was less pronounced, Perret emphasizing the unity of the exposed material. Discussing the appearance of the infill, a reviewer assimilated the pattern of the concrete panels to the technique of stone dressing.[54] The arrangement of the panels made clear that the panels were not load-bearing, yet with the use of concrete panels that fulfilled the dual function of infill and revetment, Perret moved closer to achieving the unity of materials commonly associated with stone architecture.

On the fiction of constructional truth

By 1928, Perret had formulated two of the principles that structured his definition of French modern architecture: the legibility of the skeleton, and the visibility of the material. But Perret's own search to achieve constructional truth was not free of contradictions. In many of his projects, the concrete structure was often covered by a richer revetment. In these cases, the structural material itself (the concrete) was concealed by the revetment. Perret's search oscillated ambiguously between the visibility and the legibility of the structural material, a contradiction that plagued nineteenth century Rationalist thinking.[55]

Perret's principle of constructional authenticity was challenged even by some of his works of the late 1920s. The rue Raynouard building is proof of Perret's play on semantic ambiguities. As a recent analysis has shown, the structural frame does not have the same configuration in the basement and in the upper part (fig.109).[56] While the structural grid of the upper part is closely linked with the plans of the apartments, the structural grid of the basement floors responds to other spatial constraints. As such, the structural grid expressed on the building's facade conceals the real configuration of the

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[54] H. Dupont, "Les nouveaux bâtiments du Service Technique des Constructions navales", La Technique des Travaux, vol. 8, no. 6, June 1932, pp. 332-338.

[55] On this issue, see chapter I.

[56] For a brief but perceptive analysis of the structure of the rue Raynouard building, see Treuttel, Garcias, Treuttel, "Le squelette et la jeune fille", research report, Paris, BRA/Nantes, 1991, pp. 39-55.

concrete frame. The dynamism of "infrastructure" is betrayed by the static quality of the "superstructure". The shape and treatment of the concrete elements and surfaces also varied according to their place within the structural and representational system. The rectangular posts hidden within the walls contrast with the fluted columns exposed inside the apartments. The two-meter-long cantilever of the short facade is also hidden by means of the concrete revetment. As such, the structural grid imposed on the facade conceals the real nature of modern construction. With the rue Raynouard building, Perret entertains a "constructional fiction" to impose an image of order, of regularity.[57] Perret himself was not unaware of the figural quality achieved by the concrete skeleton. In a description of the building, he stated: "It is the reinforced-concrete skeleton made to remain visible in the inside as well as the outside that ornament the house."[58] For Perret, the structural frame had ultimately become ornamental.

In fact, the representational character of the facade skeleton was already a feature of Perret's earlier projects. As Frampton correctly points out, the trabeated facade of the rue de Ponthieu garage (1906-07) concealed the real nature of the internal structure. He notes the "discrepancy between the orthogonal form of exterior trabeation and the haunched column supports carrying the beams of the reinforced-concrete skeleton within".[59] Allowing for the long cantilever required on the inside, the haunched columns were concealed by the rectangular frame of the facade. In this project, Perret clearly sought constructional authenticity in tectonic appearance -- tectonic representation.

The immeuble Maurice Lange (1929-32), built in Paris, reveals a similar discrepancy between the concrete structure and its external expression.[60] The different

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[57] Other authors have also noted the constructional fiction embodied in some of Perret's projects of the late 1920s. See Giovanni Fanelli, Roberto Gargiani, Auguste Perret, Rome-Bari, Laterza, 1991, p. 112.
[58] A. Perret, "Immeuble 51-55, rue Raynouard", manuscript note, undated (Fonds Perret, 535 AP 329): "C'est l'ossature en Béton armé composée pour rester apparente à l'intérieur comme à l'extérieur qui orne la maison". The same argument, with the same wording, appears in E. de Thubert, "Un immeuble, 51-55 rue Raynouard à Paris, par A.-G. Perret Architectes", La Construction Moderne, vol. 50, no. 19, 1934, p. 232.
[59] Frampton (see note 51), p. 126.
[60] For an analysis of the immeuble Lange, see Treuttel, Garcias, Treuttel (see note 56).

projects for the house indicate changes in plan, structure, and envelope. These changes betray the absence of a single conception of the structural frame. In the executed building, some of the posts are set back behind the facade, allowing for the placement of isolated columns on the inside. Like the rue Raynouard building, the facade of the immeuble Lange conceals the discrepancy between the superstructure and the infrastructure. In the upper floors, the internal frame is made of a regularly spaced group of isolated columns that share in the composition of the interior. The regularity of the upper columns contrasts with the irregularity of the structural frame of the lower floors, however, where an inclined concrete strut helps distribute the load to the foundation. The dynamism of the frame is here concealed behind a static facade covered with a stone-slab revetment.

On the fiction of material truth

Perret's search to achieve material truth also contained an ambiguity, which was rooted in the nature of the modern wall. In Perret's buildings, as in many buildings of the period, the wall was composed as a series of layers. Inserted between the post of the concrete frame, the wall was made of a brick infill covered with plaster tiles on the inside and a revetment (concrete, stone, or marble) on the outside. The wall of the rue Raynouard building was built on this model: while the infill was of brick, the external revetment was made of pre-cast concrete slabs. It raised the problematic issue of the function fulfilled by the external layer of the modern wall. Was the brick infill of the Chana Orloff house-studio protective or decorative? Did it belong to the construction, or to the decoration of the wall? The ambiguous nature of the modern, multi-layered wall undermined the possibility of reaching any fundamental *truth of materials*.

This ambiguity also appeared in the treatment of the concrete itself. The concrete architecture of the Salle Cortot (1928-29) is a case in point (fig.110). The Salle Cortot was a small concert hall inserted within a narrow urban lot. On the outside, both the concrete skeleton and infill were covered with thin stone slabs, the pattern of the revetment stressing the presence of the load-bearing elements. On the inside, the roughcast concrete was given a light sheen with bronze powder and completed by a brick infill revested with plywood. Perret's exploitation of concrete as both structure and surface was well noted by critics. But their reviews of the concert hall indicate the current difficulty in reading concrete constructions. In L'Illustration, Yvanhoé Rambosson, an art critic familiar with Perret's work, rightly noted: "A concrete skeleton that remains visible emphasizes the main lines of the building."[61] Yet shortly after in L'Architecte, the architectural critic Jean Porcher did not hesitate to write: "The skeleton has been left visible on the outside, roughcast", taking the legibility of the skeleton as sufficient proof of the material's visibility.[62]

Perret's treatment of concrete surfaces could also challenge the very idea of material truthfulness itself. Reviewing the concert hall in Art et Décoration, Raymond Cogniat wrote: "Now that we talk a lot about frankness in architecture, that we demand that the plan or the skeleton of constructions not be concealed, the Perrets have pushed the theory to its extreme limit, displaying materials as it has never been done before." [63] For Cogniat, Perret's extremes had to do with the treatment of the concrete on the interior. With the mode of casting adopted, the cement preserved the traces of the formwork, reproducing the knots, the nerves, the grain of the wood planks. Yet the coloration of the rough-concrete surfaces gave the impression of wood planks painted in gold. For Cogniat, it provided proof that Perret's search for the frank expression of materials could itself lead to illusionism.

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61 Yvanhoé Rambosson, "Une salle de concert construite par A. et G. Perret", L'Illustration, no. 4509, 3 August 1929, p. 123: "Une ossature de béton, qui reste visible, accuse strictement les lignes principales de l'édifice."

62 [J. Porcher], "Planches 25 à 29 - Salle de concerts de l'Ecole normale de musique, à Paris - A. et G. Perret, architectes", L'Architecte, vol. 8, no. 5, May 1930, p. 44: "L'ossature a été laissée apparente à l'extérieur, brute de décoffrage."

63 Raymond Cogniat, "Une nouvelle salle de musique de A. et G. Perret", Art et Décoration, vol. 56, October 1929, p. 128: "Aujourd'hui où l'on parle beaucoup de franchise dans l'architecture, où l'on demande de ne pas camoufler le plan ou le squelette des constructions, MM. Perret ont poussé la théorie jusqu'à ses extrêmes limites, jusqu'à 'avouer' les matériaux comme cela n'avait jamais été fait jusqu'alors."

Marcel Mayer: between classicism and romanticism

Perret's call for the respect of constructional authenticity and material truth must be examined in light of his critique of the "deceitful" practices of the modernists. By then, his critique of coating had been widely disseminated, providing the basis for a broader critique of the modern movement. The most developed interpretation of the opposition between Perret and the modernists was formulated by Marcel Mayer. From the outset, Mayer framed his critique of the avant-garde in light of the notion of "reinforced-concrete architecture", considered as an art form.[64] Mayer argued that in the contemporary movement of opinions about architecture, two doctrines were present: the "purist" and the "classical".[65] Repudiating the past, the "purists" pretended to create anew, with new means and following ideas that were new and absolute.[66] By contrast, the "classicists" were viewed as a small elite that knew how to adapt the new means to the problems of the day, but in a classical spirit.

For Mayer, the purists were doctrinaire and lacked a sense of construction, their work merely able to create a fashion.[67] By contrast, the classicists were authentic builders, producing works which renewed their art while pursuing its well-proven traditions.[68] In this interpretative framework, the art of construction was firmly associated with classicism and the French tradition. The purists were nicknamed "constructivists", making a negatively tinged reference to works and theories of foreign

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[64] Mayer's two articles published in L'Amour de l'Art in 1928 were titled: "L'architecture du béton armé."
[65] Mayer (see note 21), p. 81.
[66] Mayer (see note 21), p. 81: "Se disent puristes ceux qui, répudiant l'espérience du passé, prétendent créer de toutes pièces, avec des moyens nouveaux, selon des idées entièrement neuves et absolues".
[67] Mayer (see note 21), p. 81: "Tributaires d'un tempérament doctrinaire et dénués du véritable sens de la construction, ces "constructivistes", malgré leurs théories, ne parviennent qu'à créer une *mode*, menacée, comme toute mode -- et déjà atteinte -- de caducité."
[68] Mayer (see note 21), p. 81: "Les classiques, au contraire, véritables constructeurs, mêlant la clairvoyance et la pondération à leurs audaces, produisent des oeuvres qui renouvellent leur art tout en continuant ses traditions les plus avérées."

import.[69] Despite the use of a common material, Mayer argued, the works of this new international avant-garde lacked a personal or national character.[70]

For Mayer, modernist architects claimed to employ reinforced concrete in the reform of architecture, but their search for movement and the picturesque, their use of numerous cantilevers, their concealment of constructional elements, and their artificial use of paint were sure signs of a renewed romanticism, betrayed by their real intention to scandalize. Rejecting the works and claims of the modernists, Mayer declared: "There cannot be something called 'modern architecture'. What can be termed 'modern' in Architecture are the new needs that must be addressed."[71] Mayer understood modernism in French architecture in light of the continuity of the classical and classicism.[72] By framing contemporary French modernism in light of the nineteenth-century opposition between classicism and romanticism, Mayer refused to approach the issue of modern architecture in terms of new analytic categories. The architecture of Perret was accordingly placed under the heading of classicism, for two of the conditions necessary to attain this modern form of classicism were the expression of structure and the display of constructional materials.

Presented as such, Perret's doctrine seemed to echo the requirements dear to the nineteenth-century Rationalists, who likewise had demanded that the structure be expressed and the nature of materials be respected. As we have seen, during the later years of nineteenth century the consolidation of this doctrine generated a heated debate between the classical and Rationalist school, a debate exacerbated at the time of the 1889

69 See Jean Badovici, "Les Constructivistes", L'Architecture Vivante, vol. 3, no. 9, Fall 1925, pp. 5-10.

70 Mayer (see note 21), p. 83: "Les productions de ces mauvais bâtisseurs sont assez nombreuses sur le continent pour qu'une opinion ait pu se faire jour: le béton armé ne permet pas à un style ethnique ou personnel de se manifester. Nous retrouvons effectivement en France, en Allemagne, en Russie, en Hollande, en Belgique ou en Tchécoslovaquie, les mêmes constructions sans expression constructive, sans "style" et souvent même sans simple caractère."

71 Mayer (see note 21), p. 82: "C'est pourquoi il ne saurait y avoir 'd'architecture moderne'. Ce qu'il y a de 'moderne' dans l'Architecture, ce sont les besoins nouveaux auxquels il faut répondre."

72 Making a direct reference to a text by André Gide -- one of Auguste Perret's relatives -- published in 1921, Gargiani argues that Mayer's revival of the opposition between classicism and romanticism was probably indebted to the controversy which agitated literary circles in the early twenties. Gargiani (see note 14), p. 92.

exhibition and the celebrated triumph of iron architecture. Visibility of material was a necessary condition of Rationalist architecture, but the development of reinforced concrete threatened this doctrine through a newly apparent contradiction between visibility and truth. Yet by 1928, it was the classical trend embodied in Perret's work which demanded that the structure be expressed and that materials be visible. Mayer's definition of classicism was different from its nineteenth-century counterpart, for classicism was now conceived as an attitude rather than a style, based on principles (rhythm, composition) not on ornamental vocabulary. It was devoid of the traditional signs of the architecture of imitation. But the interpretation of Perret's work in terms of classicism during the late 1920s provides an index of how radically the Rationalist paradigms in French architecture had shifted.

Conclusion

By 1928, Auguste Perret and his circle had come to defend a particular definition of modern architecture enshrined in the notion of *architecture du béton armé*. This definition was closely tied to a new conception of concrete as the primary material of architecture. During the 1910s, Perret approached reinforced concrete as the material that succeeded the nineteenth-century episode of iron architecture. During the early 1920s, Perret saw reinforced concrete engaged in a competition with iron and steel construction, a conception that emphasized the structural character of the material. Yet by the mid-1920s concrete had been reconceived: first treated as a structural material, it was now approached in terms of its surface quality. Gradually, the attention turned to the treatment and transformation of concrete surfaces. By the mid-1920s, Perret had come to assimilate reinforced concrete with modern stone. This change of status had an effect on the treatment of the material itself. While in the early 1920s concrete could be shown in its rough state, naked, by the end of the decade it was treated like stone surfaces. By the early 1930s, using concrete for both structure and infill, Perret moved closer to the unity of materials commonly associated with stone construction. Reinforced-concrete architecture gradually acquired the attributes of stone architecture.

For Perret, legibility of structure and visibility of materials became the preconditions for the creation of an authentic modern architecture. Legibility was a proof of authenticity, an authenticating principle. As such, Perret's work and doctrine both supported the myth of constructional authenticity. With the visual expression of the concrete skeleton -- a skeleton that possessed the static quality of Greek architecture -- Perret sought to express stability and order. His concrete skeleton became a device that gave at once physical and visual order to architecture and that sustained a logic of continuity and integration. Obfuscating the fact that tectonic display was itself a practice embedded in the realm of representation, Perret opposed the truth of tectonic to the deception of atectonic architecture.

It is this belief in constructional authenticity that allowed Perret and his circle -- Paul Jamot, Marcel Mayer, Marie Dormoy, Marcel Zahar -- to criticize the architecture of the modernists for its deceptive use of reinforced concrete.[73] Focusing on coatings, Perret construed the use of coating in modern houses as the deliberate concealment of both structural frame and primary construction material. Reinforced concrete, at the basis of the new architecture, was thus accused of reinstating the architectural lie.

The idea of constructional and material truth had pervaded the discourse of the French Rationalist school.[74] Yet Perret's rejection of coating and his attempt to develop the expressive possibilities of concrete for both the structure and infill of buildings suggest an approach that seems to echo the position of John Ruskin. In the second of the Seven Lamps of Architecture, Ruskin exposed the three main deceptions of architecture, asserting his conception of architectural truth: Structural, Surface, and Operative

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[73] Mayer could write: "Aussi n'est-il pas suffisant de bâtir *avec* du béton armé pour faire de *l'Architecture béton.*" Marcel Mayer, A. et G. Perret (Les Albums d'Art Druet XVI), Paris, Librairie de France, n. d. (1928).

[74] The idea of truth was also present in the discourse of the Ecole des beaux-arts. A slogan of the Ecole (borrowed from Plotinus) read: "Le beau est la splendeur du vrai".

Deceits.[75] Writing on Operative Deceits, Ruskin rejected the use of coatings that imitate other materials, just as Perret would call for the rejection of coating as a false revetment that concealed the true nature of building materials.[76] For Ruskin, the value of a building material depended on the quality of human labor involved in its production: "For it is not the material, but the absence of the human labor, which makes the thing worthless; and a piece of terra cotta, or of plaster of Paris, which has been wrought by human hand, is worth all the stone in Carrara, cut by machinery."[77] Again like Ruskin, Perret valued the craftsmanship involved in the treatment of building materials.

By 1928, Perret's idea of constructional and material truth seemed to merge Viollet-le-Duc with Ruskin in a formulation akin to a kind of Ruskinian Rationalism. Rooted in a nineteenth-century conception of architectural truth, Perret's tectonic and material expression accorded with the traditional syntax of architecture. It was to be irremediably opposed to the new tectonic and material language developed by Le Corbusier.

2. Le Corbusier: Beyond the Rationalist Paradigm (1927-29)

In the Fall of 1927, L'Architecture Vivante devoted an entire issue to the work of Le Corbusier.[78] In the article entitled "Où en est l'architecture?" Le Corbusier discussed the state of architecture in 1927.[79] Presented in response to his European critics, the text summarized his contribution to the definition of the *machine à habiter*: "The roof-terrace-garden", "the house on pilotis", "the strip window", "the suppression of the cornice",

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[75] John Ruskin, "The Lamp of Truth", The Seven Lamps of Architecture, London, 1849 (reprint, New York, The Noonday Press, 1961, pp. 39 ff).
[76] Ruskin wrote: "... neither must we use any artificial stone cast into shape, nor any stucco ornaments of the color of stone, or which might in anywise be mistaken for it..." Ruskin (see note 75), p. 58.
[77] Ruskin further wrote: "For the ductile and fusible materials, as clay, iron, and bronze, since these will usually be supposed to have been cast or stamped, it is at our pleasure to employ them as we will; remembering that they become precious, or otherwise, just in proportion to the hand-work upon them, or to the clearness of their reception of the hand-work of their mould." Ruskin (see note 75), p. 58.
[78] Le Corbusier, in L'Architecture Vivante, vol. 5, no. 17, Fall 1927, pp. 5-28.
[79] Le Corbusier, "Où en est l'architecture ?" (see note 78), pp. 7-11.

"the free plan", "the free facade".[80] This enumeration of design principles echoed the systematized set of principles proposed by Le Corbusier in the context of the Weissenhof exhibition, the body of rules that came to be known as the "Five Points for a New Architecture".[81] The Five Points first appeared in German in the booklet on Le Corbusier's Weissenhof houses written by Alfred Roth.[82] The original version of the Five Points, written in French and dated 24 July 1927, read: 1. *Les pilotis*, 2. *Les toits-jardins*, 3. *Le plan libre*, 4. *La fenêtre en longueur*, 5. *La facade libre*.[83] Unlike the original version, the number of principles listed in the Architecture Vivante article amounted to six, the unexpected sixth observation referring to "the abolition of the cornice". In the article, each of these architectural observations was deemed to be the manifestation of a "research of pure technique".

The Architecture Vivante article also contained a series of technical sketches and drawings that described the principles developed by the architect. In the text that accompanied the sketches, reinforced-concrete construction was clearly posited as the key technical determinant of these architectural developments. Le Corbusier wrote: "Thanks to reinforced concrete exploited to its full extent, we now have an architectural system totally new and of the greatest purity."[84] Each of the points or principles was closely associated with this modern material: "Reinforced concrete gives the flat roof, liberating us from age-old subjections", "Reinforced concrete gives us the pilotis", "Reinforced concrete triggers a revolution in the history of the window", "Reinforced concrete in the small house brings the free plan".[85] According to these formulations, the technology of

80 "Le toit-terrasse-jardin", "les maisons sur pilotis", "la fenêtre en longueur", "la suppression de la corniche", "le plan libre", "la façade libre".
81 "Les 5 Points d'une architecture nouvelle" in Le Corbusier, Pierre Jeanneret, Oeuvre complète 1910-29, Zurich, Girsberger, 1937 [Zurich, Artemis, 1964], pp. 128-129.
82 See chapter V.
83 For the original French version, see Werner Oechslin, "Les Cinq Points d'une Architecture Nouvelle", Assemblage, no. 4, October 1987, pp. 83-93.
84 Le Corbusier (se note 78), p. 17: "Nous disposons maintenant, grâce au ciment armé poussé dans toute ses conséquences, d'un système architectural entièrement neuf et de la plus totale pureté."
85 Le Corbusier (see note 78): "Le béton armé nous dotant du toit plat nous apporte la libération des sujétions séculaires" (p. 18); "Le ciment armé nous donne les pilotis." (p. 19); "Le ciment armé fait

concrete construction was "systematically represented as the release mechanism for a new architecture".[86]

This extensive discussion of Le Corbusier's architectural principles appeared in the fall of 1927, some time after the publication of Roth's booklet. But the article entitled "Où en est l'architecture?" was apparently written and published before. A note at the end of the article indicates that it first appeared in the Europaïsche Revue of 1 May 1927. This indication is important, and could explain the discrepancies between the Five Points and the six "observations". Destined for a European audience, the May article addressed the emerging polemic on the question of functionalism. There, Le Corbusier responded to criticisms raised by foreign architects regarding the overtly artistic inclination of his work. The article gave him the occasion to formulate the formal characteristics of the modern house in a systematic way. It is most probably on the basis of this article that Le Corbusier formulated the version dated July 1927, reducing the six "observations" to the canonic Five Points. Thus titled and numbered, the Five Points acquired the form of a theoretical tract, a status confirmed by Le Corbusier's own introductory statement: "Here are the theoretical conclusions derived from the successive observations made on the building site over a number of years."[87] The systematic quality of the Five Points is further confirmed by Oechslin's analysis of the original text: "In the manuscript, *successives* replaces the crossed-out word *fréquentes*. In this manner, the process of a logical sequence of observations is emphasized, as opposed to the mere accumulation of frequently recurring remarks, just as this is represented in the continuation of the idea for the maison Citrohan up to Stuttgart."[88]

Oechslin's analysis focuses, however, on the theoretical coherence of the Five Points, not on their textual sources. The Five Points were not formulated at once, but

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révolution dans l'histoire de la fenêtre." (p.19); "Le béton armé dans la petite maison apporte *le plan libre*." (p. 24).

86 Oechslin (see note 83), p. 92.

87 Oechslin (see note 83), p. 86: "Ce sont ici les conclusions théoriques d'observations successive faites dans les chantiers depuis plusieurs années".

88 Oechslin (see note 83), p. 85.

were rather the result of a textual process of accretion and transformation. In fact, each of the principles was rooted in Le Corbusier's previous formulations and statements. The footnotes added to the Architecture Vivante article clearly indicate that some of the "observations" had previously appeared in the Almanach d'Architecture Moderne published in 1926.[89] In fact, Le Corbusier's "observations" were largely indebted to his experience within French architectural culture.[90] This gradual process of definition coincided with the architect's own work on the modern house. An analysis of this process reveals how Le Corbusier arrived at the formulation of the "architectural consequences" of reinforced-concrete construction.

Théorie du toit-jardin

Starting with the Dom-ino house, most of Le Corbusier's housing projects of the late 1910s had flat roofs. The only exception was the maison Monol, a project that advocated an innovative vaulted roof structure. The first published statement on the need to abandon the pitched roof was in Ozenfant's review of the villa Schwob.[91] The flat roof of the villa Schwob was presented as a dictate of the development of central heating, a development that had a key aesthetic consequence. In this discussion on the flat roof, reinforced-concrete construction was not mentioned. The second published occurrence was in the article on the 1923 Salon d'Automne. Noting that houses with terraces were being proposed at the exhibition, Le Corbusier rejected the commonly held conception that flat

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[89] Le Corbusier, Almanach d'Architecture Moderne, Paris, Crès 1926. The material of the Almanach was to appear in the number 29 of L'Esprit Nouveau, planned for the end of 1925. The preface of the Almanach is dated November 1925, but one article contains material that appeared in the December 1925 issue of La Science et la Vie, pushing the possible date of completion of the manuscript to the very end of the year 1925. See R. Gabetti, "Presentazione" in Ch.-E. Jeanneret Gris (Le Corbusier), Almanach d'Architecture Moderne, Turin, Bottega D'Erasmo, 1975.

[90] In their study on the "confrontation" between Auguste Perret and Le Corbusier, Giovanni Fanelli and Roberto Gargiani have shown that many of Le Corbusier's architectural "observations" were related to his debate with Perret. G. Fanelli, R. Gargiani, Perret e Le Corbusier, confronti, Rome-Bari, Laterza, 1990.

[91] He wrote: "le cube remplace la pyramide hésitante des toits et supprime cette fâcheuse hétérogénéité de la couverture et du mur." Julien Caron [alias Ozenfant], "Une villa de Le Corbusier 1916", L'Esprit Nouveau, no. 6, March 1921.

roofs caused leakage problems.[92] It is only in his Sorbonne conference of June 1924, reprinted in the Almanach, that Le Corbusier introduced the idea of the flat roof in terms of reinforced-concrete construction. In a long discussion of the reasons for adopting the flat roof in modern houses, Le Corbusier insisted on the consequences of modern techniques: "The sloping roof was formerly the only means of draining off rain water. But since the end of the 19th century, Portland cement permits the creation of flat roofs, in terraces, that are perfectly waterproof."[93]

The reasons given for developing the roof terrace were derived from his building experiences in the Swiss Jura, which he treated as a kind of laboratory experiment. For Le Corbusier, the disappearance of the traditional roof had obvious aesthetic consequences, but he argued that the technical argument took primacy and gave legitimacy to the aesthetic discussion. Giving the example of the movement for the flat roof in Germany, he wrote: "They did not approach the problem correctly, they did not provide the technical reason that satisfies the mind, that allows one to go forward in good conscience: with a technical reason that confirms and reassures the mind, one can admit the beauties of geometry, of the orthogonal, since they are henceforth authorized, even dictated by the fundamental technical conditions of the problem."[94]

Le Corbusier's first experiment with the roof-garden was in the construction of the double villa La Roche-Jeanneret.[95] The shift from the flat roof to the roof-garden was duly registered in the Almanach d'Architecture Moderne, where Le Corbusier wrote:

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92 Le Corbusier, "Ce Salon d'Automne", L'Esprit Nouveau, no. 19, December 1923, n.p.

93 Le Corbusier, "L'Esprit Nouveau en Architecture", Almanach d'Architecture Moderne (see note 89), p. 33: "Le comble incliné était, autrefois, le seul moyen d'évacuer les eaux de pluie. Or, dès la fin du XIX^e siècle, le ciment Portland permet de faire des toitures plates, en terrasses, absolument étanches."

94 Le Corbusier (see note 93), pp. 34-35: "Mais on n'avait pas envisagé le problème par le bon coté, on n'avait pas donné la raison technique qui satisfait l'esprit, qui donne une bonne conscience et permet d'aller de l'avant: avec une raison technique qui confirme l'esprit dans ses droits et le rassure, on peut alors admettre les beautés de la géométrie, de l'orthogonal puisque les voici dorénavant autorisées, même commandées par les conditions techniques essentielles du problème."

95 On the sources of the roof-garden, see "Il tetto-giardino", Rassegna.

"Reinforced concrete brings the flat roof and revolutionizes the use of the house."[96] The drawings made in support of the argument illustrated the rapport between the techniques and the forms of domestic roof types. Three drawings positioned the flat roof at the end of a stylistic genealogy: Renaissance, Louis XIV, Béton armé. The subsequent passage explained in words and images that "the garden is also at the top of the house, on the roof."[97]

This subtle shift from the flat roof to the roof-garden was registered in Le Corbusier's answer to the questionnaire Gropius sent from Dessau. Le Corbusier's response -- published in Bauwelt in April 1926 -- substantiated the technical justifications sought by Gropius.[98] With Le Corbusier's reply, for the first time in a longstanding controversy in Germany, "no significant mention was made of style, culture, landscape, or environment."[99] In the article, the development of the roof-garden was primarily justified by means of a technical argument. Since the surface was subject to cracking because of the sudden expansion of concrete, Le Corbusier argued for the need to maintain a certain degree of humidity on the roof. The garden on the roof became a natural means by which to achieve this goal.

At the Weissenhof, Mies specified the flat roof as the one requirement for the sixteen participants in the housing exhibition.[100] Le Corbusier responded with the construction of roof gardens on the two houses and with the formulation of one of the Five Points. In the second point, titled *Die Dachgärten*, Le Corbusier sustained an argument that was primarily technical in an attempt to give it a more universal value. Yet

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96 Le Corbusier (see note 89), p. 15: "Le béton armé apporte le toit plat et révolutionne l'usage de la maison".

97 Le Corbusier (see note 89), p. 15: "le jardin est aussi dessus la maison, sur le toit."

98 Walter Gropius, "Das flache Dach: Internationale Umfrage über die technische Durchführbarkeit horizontal abgedeckter Dächer und Balkone," Bauwelt, XVII, April 1926. This issue was taken up by Ernst May in Frankfurt. Le Corbusier, "Die Eroberung des Flachen Daches", Das neue Frankfurt, no. 7, December 1927.

99 Richard Pommer, "The Flat Roof: A Modernist Controversy in Germany", Art Journal, no. 43, Summer 1983, p. 163.

100 Pommer (see note 99), p. 164.

in his subsequent discussion on the *théorie du toit-jardin* in L'Architecture Vivante, the technical discussion -- which was a French version of the text published in Bauwelt -- was accompanied with sketches that depicted the stylistic sequence of French roof types, in a conscious attempt to give it a national grounding (fig.111).

Le Corbusier's *théorie du toit-jardin* was the end result of discursive construction that subtly exploited the technical argument. In the case of the villa Schwob, the rejection of the pitched roof was linked to the development of central heating. It was only later, with the Sorbonne conference of 1924, that the flat roof came to be linked with the technique of reinforced-concrete construction. The transition from the flat roof to the roof-garden was further argued in terms of the architect's better understanding of concrete construction. The role attributed to reinforced-concrete construction as such was thus deeply ideological, providing Le Corbusier with the means to ignore or challenge the logic of cultural conventions.

La maison sur pilotis

The first occurrence of the pilotis appeared in the second version of the maison Citrohan, a project first presented at the 1922 Salon d'Automne and in Vers une architecture. There, however, the concrete posts that lifted the building from the ground were not yet described -- and construed -- as pilotis. The concrete posts of the Citrohan II were conceived as prefabricated structural elements, in continuity with the research initiated by the Dom-ino frame. The raising of the basement on square posts partook of the figuration of the "house as a machine," based on a simplified building process. It is only in the project for the villa La Roche that some of the vertical posts were turned into pilotis. The pilotis appeared in the fourth project of the villa, developed at the close of 1923. In this project, the gallery wing was carried by a wall and two posts separated by more than ten meters, a structure complemented by three isolated posts.[101] The post placed at the center

[101] Gilles Ragot, "Le mouvement moderne 1922-1933. Exigences et compromis", doctoral dissertation, Paris, Paris IV-Sorbonne, October 1993, vol. 1, p. 272.

of the executed gallery wing was round and pushed slightly behind the facade, emphasizing its figurative function.

Le Corbusier's first theoretical formulation on the pilotis appeared in his urbanistic discourse. In Vers une architecture Le Corbusier criticized a project conceived but not drawn by Auguste Perret.[102] Referring to one of his own projects entitled "Les villes pilotis" -- a project surprisingly dated 1915 -- he wrote: "The ground of the city is raised by 4 or 5 meters on pilotis that serve as foundations for the houses."[103] In Urbanisme, published in 1925, Le Corbusier recapitulated his theoretical statements on the pilotis.[104] The function of the pilotis was made clear in his discussion of the Lotissements Fermés à Alvéoles: "Each roadway is entirely built on concrete pilotis and accepts only light automobile traffic; the roadway is *in the air*, on pilotis."[105]

The role of the pilotis in the modern house was discussed for the first time in the 1926 Almanach d'Architecture Moderne, a discussion that took place after initial studies on the maison Planeix and before the design of the maison Cook.[106] "The house", Le Corbusier wrote, "was sinking into the ground: dark and damp rooms. Reinforced concrete gives us the pilotis. The house is in the air, far from the ground...."[107] In Urbanisme, the pilotis were used to raise the roadways, the author insisting on the separation of types of vehicular traffic. In the Almanach, the pilotis were used to raise the house from the ground, Le Corbusier hinting at the hygienic improvement introduced by this operation. In the text of the Five Points, he was more explicit about the source and

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102 Le Corbusier-Saugnier, "Trois Rappels, le plan", Vers une architecture, Paris, Editions Crès, 1923, p. 44 (new edition, Paris, Editions Vincent, Fréal & Cie, 1958).

103 Le Corbusier (see note 102), p. 45: "Le sol de la ville est surélevé de 4 à 5 mètres sur les pilotis qui servent de fondation aux maisons."

104 Le Corbusier, Urbanisme, Paris, Crès, 1925.

105 Le Corbusier, "La liberté par l'ordre", Urbanisme (see note 104), p....: "Chaque chaussée est entièrement construite de béton et elle ne reçoit que la circulation légère des automobiles; elle est *en l'air*, sur pilotis."

106 The role of the pilotis was also mentioned in another article published in 1926. Le Corbusier wrote: "la maison a tout intérêt à être en l'air (sur pilotis) et non directement sur le sol." Le Corbusier, "Architecture d'époque machiniste," Journal de psychologie normale et pathologique, 15 January-15 March 1926, p. 20 (reprint Turin: Bottega d'Erasmo, 1975).

107 Le Corbusier (see note 89), p. 15: "La maison s'enfonçait dans le sol: locaux obscurs et souvent humides. Le ciment armé nous donne les pilotis. La maison est en l'air, loin du sol...."

function of the pilotis. Distinguishing between load-bearing and non-load-bearing elements, he wrote that the pilotis replaced the traditional walls, and that the foundation of each pilotis had to be calculated according to the load it was to carry. The description also contained, in germ, the notion of structural grid: "These pilotis are regularly spaced without taking into account the interior plan of the various levels."[108]

In Le Corbusier's projects for the Weissenhof, the pilotis played a key role in the formal definition of the modern house. Rising from the foundation to the top of the houses, the pilotis proposed a new expression of the structural skeleton. This importance was recognized by the primacy of place given the pilotis in the order of the Five Points. But this definition came late in Le Corbusier's work, and only after having first applied the term in the context of his urbanistic research. As such, the pilotis were not merely another term by which to designate concrete posts, but a notion that enshrined the expressive function of the modern reinforced-concrete frame.

La fenêtre en longueur

The definition of the window occupied an important place in Le Corbusier's research. Making reference to his early proposals based on the Dom-ino frame, Le Corbusier wrote in 1921 that "the windows would turn around the house", hinting at one of the possibilities offered by the concrete frame.[109] But his interest for the compositional and functional role of the window was most clearly spelled out at the time of the 1923 Salon d'Automne, in the context of the debate with Perret. Responding to Perret's critique, Le Corbusier declared in the pages of Paris-Journal: "All my architecture revolves around the window. Windows fully adapted to the new conditions of reinforced-concrete and metal work, but also re-adapted to human functions."[110] It is in this polemical context that Le

108 Oechslin (see note 83), p. 86: "Ces pilotis sont disposés régulièrement sans tenir compte des dispositions intérieures des divers étages."

109 Le Corbusier-Saugnier, "Maisons en série", L'Esprit Nouveau, no. 19, December 1921, p. 1534.

110 Guillaume Baderre, "Une visite à Le Corbusier-Saugnier", Paris-Journal, 14 December 1923, p. 6: "Toute mon architecture est fonction des fenêtres. Fenêtres entièrement adaptées aux conditions nouvelles du ciment armé et de la métallurgie, mais réadaptées aussi aux fonctions humaines."

Corbusier phrased his concern for the mass production of window frames. In a second article published in the same journal, Le Corbusier further argued that with the freedom allowed by reinforced concrete it was possible to revise the form of the window, and adopt the strip window [*fenêtres en bande*].[111] This idea was illustrated with a plan of Le Corbusier's "petite maison" at Corseaux, a house planned for his parents near lake Leman in Switzerland. The debate initiated in Paris-Journal was soon to be formalized in terms of the opposition between Perret's vertical window and Le Corbusier's strip window.[112]

In the 1924 Sorbonne conference, Le Corbusier reiterated the technical basis of the strip window. He traced the evolutionary process of the window, insisting on the possibilities and limits of stone construction. At the end of this process, the strip window was presented as the consequence of a new technical fact: reinforced concrete. With the substitution of a concrete skeleton to the traditional load-bearing walls, the new house was made of a grid of posts and beams that left between them large open surfaces [*vides totaux*]. From the outset, this technical consequence was closely tied to aesthetic and functional considerations. Indeed, this technical argument was merely the basis on which to ground his demonstration relative to the new lighting function of the strip window. Moreover, this new technical fact was to have immediate aesthetic consequences. These conclusions were to be synthesized in the Almanach d'Architecture Moderne: "The window is one of the essential elements of the house. Progress has a freeing function. Reinforced concrete causes a revolution in the history of the window".[113] Presented as the end result of an evolutionary process that led from the Gothic to the eighteenth century to Haussmann, the fate of the strip window appeared to be merged with the reinforced-concrete skeleton (fig.112). Moreover, in his "Appel aux industriels" of the

[111] G. Baderre, "Seconde visite à Le Corbusier", Paris-Journal, 28 December 1923, p. 3.

[112] Le Corbusier, "Petite contribution à l'étude d'une fenêtre moderne", Almanach d'Architecture Moderne (see note 89), pp. 95-97. On this debate, see Bruno Reichlin, "Für und wider das Langfenster. Die Kontroverse Perret-Le Corbusier", Daidalos, no. 13, 1984, pp. 65-77.

[113] Le Corbusier (see note 89), p. 14: "La fenêtre est l'un des buts essentiels de la maison. Le progrès apporte une libération. Le ciment armé fait révolution dans l'histoire de la fenêtre."

same year, where Le Corbusier reiterated his concern for the industrialization of window frames, the rectangular configuration of the standard modules was then strategically justified on the basis of the regular spaces generated by the concrete skeleton.[114]

Le plan libre

Though the idea of the free plan pervaded Le Corbusier's architectural research throughout the 1920s, the notion of *plan libre* appeared late in his theory. While its first documented occurrence was in the Europaïsche Revue article of May 1927, the *plan libre* was described only in the original version of the Five Points dated July 1927: "The pilotis rise up to the roof, carrying the floors. They do not hamper the arrangement of the vertical partitions that are different at each level. There are no more load-bearing walls, there are instead light membranes and all the floors are different from each other. Absolute freedom of the plan."[115]

The idea of the free plan was to be formulated for the first time in the context of the unexecuted project for the villa Meyer at Neuilly (1925-26) and embodied in the project of the maison Cook (1926). That Le Corbusier viewed the villa Meyer as a true manifestation of the free plan is confirmed by the fact that it is the villa's project that served to illustrate the discussion of the *plan libre* in the 1927 issue of L'Architecture Vivante.[116] Commissioned in the spring of 1925, the villa was the object of four different studies made between April 1925 and June 1926.[117] A letter from Le Corbusier to Mrs. Meyer dated October 1925 provided a vivid description of the second variant. In the letter, the textual description of the project was illustrated with sketches (fig.113). Le Corbusier wrote:

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[114] Le Corbusier, "Appel aux industriels", Almanach d'Architecture Moderne (see note 89), pp. 102-103.

[115] Oechslin (see note 83), p. 87: "Les pilotis se poursuivent jusqu'à la toiture, portant leur planchers. Ils ne gênent aucunement la disposition des cloisons verticales qui sont différentes à chaque étages. Il n'y a plus de murs portants, il y a des membranes légères et tous les étages sont différents les uns des autres. Liberté absolue du plan."

[116] Le Corbusier (see note 78), pp. 21-24.

[117] On the villa Meyer, see Tim Benton, The Villas of Le Corbusier 1920-1930, New Haven - London, Yale Univ. Press, 1987, pp. 142-153.

> These ideas ... these architectural themes which bear within them a certain poetry are subject to the most rigorous constructive laws.... Twelve concrete piers, equally spaced out, carry the floors at little expense. In the concrete framework thus constituted, the plan is deployed with such simplicity that one might be tempted (how easily tempted!) to consider it naive....[118]

In this variant, the deployment of the plan was viewed as a consequence of the regular structural grid. But the plan -- especially the second-floor plan -- was not yet totally free.

The variant illustrated in L'Architecture Vivante was not the second scheme, but the third one dated April 1926. In this scheme, the grid had become irregular, with bays spanning respectively 5 meters, 2.5 meters, and about 1.25 meters. The narrow bay along the front of the house was cantilevered, allowing for the display of the *fenêtre en longueur*. The differences between the October 1925 and April 1926 schemes is indicative of the process that led Le Corbusier to define the free plan. In the October 1925 scheme, the plan was deployed with simplicity within a regular grid. In the April 1926 scheme, the free plan was achieved by means of an irregular grid with posts set back from the facade. It is this process that Le Corbusier described in L'Architecture Vivante. After having noted the substitution of concrete posts for traditional load-bearing walls, he added: "Then these posts left the corners, quietly remaining in the middle of the rooms."[119] For Le Corbusier, the use of the concrete skeleton was a necessary but not a sufficient condition for the development of the free plan. A further condition was that the concrete posts be set back from the walls, giving the structural posts an expressive and compositional role. The free plan came to be theorized only after the concrete posts had been turned into expressive pilotis.

La façade libre

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[118] Le Corbusier, letter to Mrs. Meyer, October 1925 (FLC 31525). Cited in Benton (see note 117), p. 144.

[119] Le Corbusier (see note 78), p. 24: "Puis ces poteaux ont quitté les angles, sont demeurés tranquillement au milieu des pièces."

As with the *plan libre*, the concept of the *façade libre* took some time to be formulated. In the original version of the Five Points, Le Corbusier wrote that the achievement of the free facade was made possible when the facade was devoid of any load-bearing function.[120] As such, the development of the free facade clearly depended on the exploitation of the reinforced-concrete frame. However, this new status was only to be achieved when the structural posts were to be set behind the facade and when the wall was to be turned into a membrane.

Le Corbusier's first discussion of the new nature of the modern wall was at the 1924 Sorbonne conference.[121] In this conference, Le Corbusier showed how the reinforced-concrete skeleton had turned the wall into a light membrane tied to the structural frame. Again it was only when the posts were set back from the vertical datum of the wall that the free facade could develop. The idea of the free facade was to develop from Le Corbusier's attempt to further the expression of the wall as a skin, and was clearly spelled out in the October 1925 letter to Mrs. Meyer. Le Corbusier wrote: "The posts set back from the facades, inside the house. The floor is cantilevered. The facades become mere light membranes of insulating walls or windows. The facade is free; the windows, without interruptions, can open from one side to the other."[122] Yet it is only after the completion of the maison Cook, with the effective separation of the wall membrane from the structural skeleton, that the free façade was first materialized.

In his discussion of the free facade in L'Architecture Vivante, Le Corbusier made reference to the Dom-ino project: "The posts were placed behind the facade, inside the house: the 'DOMINO' framework. Ten years later, continued experimentation with

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120 Oechslin (see note 83), p. 88.

121 Le Corbusier (see note 78), p. 33: "Grâce aux matériaux modernes, le mur n'est plus constitué que d'une fine membrane de briques ou de tout autre produit formant cloison, doublé d'une seconde membrane intérieure..."

122 Le Corbusier (see note 118) letter to Mme. Meyer, October 1925: "Les poteaux en retrait des façades, à l'intérieur de la maison. Le plancher se poursuit en porte-à-faux. Les façades ne sont plus que des membranes légères de murs isolants ou de fenêtres. La facade est libre; les fenêtres, sans être interrompues, peuvent ouvrir d'un bord à l'autre de la façade."

reinforced concrete brings us once again to this solution: the posts inside the house."[123] With the words "once again", Le Corbusier hinted that this return to the practice of "posts inside the house" was no mere repetition, but a new architectural interpretation of a similar structural configuration. For if in the Dom-ino frame the posts were set back from the facade, they were not yet exploited to express the new nature of the wall as a skin, clearly separated from the structural skeleton. It is only later, with the projects for the Meyer and Cook houses, that the concept of the free facade was to find its full expression.

Le Corbusier and the "système de structure"

As the preceding analysis shows, the reinforced-concrete frame was central to the formulation of the Five Points. Or more accurately, it was the research into the possibilities of the frame that triggered the theoretical elaboration of the Five Points. In this theoretical statement, the emphasis was placed on reinforced concrete as a building system, not as a material in the conventional sense. This retrospective analysis reveals the complex interaction as well as the absence of any determining relation between technical solutions and aesthetic choices, between the building system and the architectural form. Le Corbusier stated that he was searching for the "architectural consequences" of reinforced-concrete construction. Yet as we have seen, this search was not a one-way process. The technical reasons given for each of the Five Points were often mere rationales for Le Corbusier's aesthetic choices. As he himself underlined, technical justifications were necessary only to establish the logic behind any aesthetic choice. As such, the Five Points were the result of a process that attempted to integrate both technique and aesthetic in a syncretic fashion. With the Five Points, Le Corbusier went

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[123] Le Corbusier (see note 78), p. 24: "Les poteaux étaient en retrait des façades, à l'intérieur de la maison: ossature 'DOMINO'. Dix ans plus tard, une expérimentation constante du ciment armé nous conduit à nouveau à cette solution: les poteaux à l'intérieur de la maison."

beyond the conventional Rationalist rhetoric of other modernist architects to define a constructional and aesthetic code for the modern house.

In a study of the confrontation between Perret and Le Corbusier, Giovanni Fanelli and Roberto Gargiani have argued that the cultural inheritance of Viollet-le-Duc appears central to the thinking of Le Corbusier until the mature phase of his theoretical reflections in the second half of the 1920s.[124] According to these authors, Le Corbusier was profoundly indebted to Viollet-le-Duc's idea of structure, an indebtedness mostly revealed in his use of the expression "système de structure".[125] Yet, in the same chapter of the book, Fanelli and Gargiani do not hesitate to stress the antistructuralist character of Le Corbusier's work of the 1920s.[126] This contradictory reading highlights the difficulty of interpretating the role of the structural framework in Le Corbusier's theory and work. It is only because Fanelli and Gargiani approach the notion of structure in terms inherited from nineteenth-century French architectural culture that Le Corbusier's modern tectonic discourse is so unproblematically affiliated with its nineteenth-century counterpart.

In his 1928 article on the Weissenhof houses, Le Corbusier effectively insisted on the importance of the notion of *système de structure*.[127] From the outset, he insisted on the need to achieve standardization, industrialization, taylorization. The main goal was "to standardized the *système de structure*."[128] This new structural system was to be open to

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[124] They write: "Il mito delle origini gotiche e neogotiche dello strutturalismo perretiano (...) appare a una verifica storica più approfondita poco convincente. L'eredita culturale di Viollet-le-Duc appare invece centrale nel pensiero di Le Corbusier fino ai testi della fase matura delle sue riflessioni teoriche sull'architettura, nella seconda metà degli anni Venti, nei quali ricorrono concetti chiave del pensiero di Viollet-le-Duc, come il "sistema di struttura". Fanelli, Gargiani (see note 90), p. 183.

[125] They note that the expression "système de structure" was employed by structural Rationalists like Anatole de Baudot (1916) and Paul Voirin (1917). Fanelli, Gargiani (see note 90), p. 183. In a 1925 article, Voirin further insisted on the importance of the *système de structure* as opposed to the materiel: "C'est du *système de structure* du ciment armé que naîtra un art et non de sa matière". P. Voirin, "L'architecture française de l'exposition", Le Rationaliste, 6th serie, no. 25, November-December 1925, p. 428.

[126] They write: "La qualificazione formale della villa per Gabrielle de Monzie e Michael e Sarah Stein a Garches (1926-28) segna il punto più alto in questa che si potrebbe definire 'poetica antistrutturalista'". Fanelli, Gargiani (see note 90), p. 171.

[127] Le Corbusier, "La signification de la Cité-Jardin du Weissenhof, à Stuttgart", L'Architecture Vivante, vol. 6, no. 19, Spring 1928, pp. 9-15.

[128] Le Corbusier (see note 127), p. 10: "il s'agit de standardizer le système de structure."

standardization, and be rich in terms of architectural potential. The structural system was not itself the generator, but a precondition of the genesis of the new aesthetic. The houses built in Stuttgart served as a demonstration of the revolutionary conceptions made possible by this structural system.[129]

Le Corbusier's break with nineteenth-century structural Rationalism is readily apparent here in the new function given to the structural skeleton, a function stressed in Banham's description of the architet's later projects at Garches and Poissy:

> In both houses the frame is an absolute three-dimensional grid which exists independently of the planning of the various floors -- not only do stray columns pass through some rooms in seemingly awkward places, but in some instances walls that could comfortably have filled-in the spaces from column to column, have apparently been deliberately joggled out of line to leave the structure in clear distinction from the partitioning.[130]

Le Corbusier's emphasis on the internal logic of the concrete frame reveals the need to examine his conception of the structural skeleton in relation to the architectural object as a whole. In a perceptive analysis of the two Weissenhof houses, Bruno Reichlin proposes a structural understanding of the Five Points: "The Five Points proposed a comprehension of the architectural object in structural terms: objects, elements, and phenomena pertaining to its production -- material, statico-constructional, functional, spatial, plastic, symbolic -- and the means of production, are cultivated in their structural relationships, like a system *où tout se tient*."[131] In this system of relations, the concrete frame was not the object of a specific theoretical statement, autonomously defined, but an entity that gained its meaning through the definition of each "architectural principle". In our analysis of Le Corbusier's conception of the *système de structure*, the attention must

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129 Le Corbusier wrote: "Je dis donc qu'à Stuttgart nous avons voulu montrer les conceptions architecturales révolutionnaires qu'entraînent de nouvelles structures appliquées à la construction de la maison." Le Corbusier (see note 127), p. 11.

130 R. Banham, Theory and Design in the first Machine Age, New York, Praeger Publishers, 1960, p. 262.

131 Bruno Reichlin, "The single-family dwelling of Le Corbusier and Pierre Jeanneret at the Weissenhof", in In the Footsteps of Le Corbusier (ed. by C. Palazzolo, R. Vio), New York, Rizzoli, 1991, pp. 37-57.

shift from the structure (in Rationalist terms) to the *système* (in structuralist terms).[132] It is only by overcoming the conventions of structural rationalism that one can begin to understand the relation between the concrete frame and the Five Points, and the subsequent relativization of reinforced concrete itself.

Beyond local / domestic architecture

The Five Points were drafted to address the conception of the modern house, but their formulation already hinted at the fact that they could be applied to buildings of another scale. In the statement on the free facade written in the June 1927 version, Le Corbusier stressed that the *fenêtres en longueur*, measuring 10 meters in a small house, could very well be extended to measure 200 meters in the case of a palace.[133] He then referred implicitly to his project for the Palace of the League of Nations in Geneva, submitted in the summer of 1927. In Une maison - un palais published in 1928, Le Corbusier extended the description of the Palais des Nations in Geneva in light of the principles of the Five Points.[134] As in the case of the house, the strip window, the pilotis, and the free facade of the office building complex were argued in terms of reinforced-concrete construction (fig.114).[135] Again as with the house, Le Corbusier questioned the logic of traditional architecture: "We have done away with thick foundation walls.... Our regularly spaced pilotis support and distribute the building load better than traditional walls."[136] Derived from Le Corbusier's work on the modern house, the theoretical statements of the Five Points openly aimed at the larger architectural domain.

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132 In a brief study on Viollet-le-Duc, Hubert Damisch proposes to analyze the *Dictionnaire raisonné* in structuralist terms. According to Damisch, the structural analysis of architectural phenomena encourages a distinction between the level of structure and the level of form, and requires a questioning of their mode of articulation, both concrete and theoretical. See H. Damisch, "Introduction", in E.-E. Viollet-le-Duc, l'Architecture raisonnée, Paris, 1964.

133 Oechslin (see note 83), p. 88.

134 A transition examined in Le Corbusier's book published in relation with the competition for the Palais des Nations in Geneva. Le Corbusier, Une maison - un palais, Paris, Crès, 1928.

135 Le Corbusier (see note 134), pp. 100-101.

136 Le Corbusier (see note 134), p. 94: "Nous n'avons élevé aucun mur épais de soubassement... Nos pilotis à équidistance supportent et répartissent mieux que des murs les charges de l'édifice."

Developed in the context of his research on the reinforced-concrete frame as applied to the conception of the modern house in France, Le Corbusier's Five Points were at once national and domestic. Despite this context, Le Corbusier's ultimate goal was the formulation of a code that could claim universal value. This belief was made more evident at the first CIAM congress held in La Sarraz in June 1928. Organized in the aftermath of the controversial competition for the Palace of the League of Nations, one of the aims of the congress was to discuss conditions for the development of modern architecture. During the congress, Le Corbusier considered the possibility of triggering a general discussion on the Five Points, an indication of his belief that the Five Points could be taken as general design principles.[137] It also reveals a shift from the material basis of the Five Points. First derived from Le Corbusier's experimentation with reinforced-concrete construction, the Five Points could now be approached as autonomous design principles independent from the material that presided in their definition.

The *système de structure*: from reinforced concrete to metal

The Five Points primarily derived from research into the reinforced-concrete frame. But their formulation already hinted at the fact that they were achievable outside the limited domain of concrete construction. Le Corbusier's insistence on reinforced concrete was intimately connected with the cultural and economic context of architectural production in France in the 1920s. From his early articles in L'Esprit Nouveau to his contributions to L'Architecture Vivante in the his late 1920s Le Corbusier always insisted on the key role of the reinforced-concrete frame. The place of concrete construction was enshrined in his praise of the mason, viewed as the central figure of the modern building site. "Before reinforced concrete, all building trades on the site, to build a house. After twenty years

137 Jean-Louis Cohen, "L'architecture d'André Lurçat (1894-1970): autocritique d'un moderne", doctoral dissertation, Paris, EHESS, 1985, vol. 1, p. 278.

use of reinforced concrete, we can dream of only one building trade on the site: the mason."[138]

Yet at the time of the formulation of the Five Points, Le Corbusier was already struggling with the possibility of divorcing the principles from any specific material or system. This attempted abstraction is highlighted by the discrepancy between the German version of the Five Points and the text of L'Architecture Vivante. In the text aimed at the German public, Le Corbusier puts much less emphasis on the material basis of the skeleton. More theoretical in character, the *Fünf Punkte* suggested a possible abstraction from any specific building system. Le Corbusier's emphasis on the *système de structure* -- in constructional and structuralist terms -- hinted at the relativization of reinforced concrete as the priviledged building material. It already prefigured the research of the late 1920s into the *maison à sec* and the substitution of steel for reinforced-concrete construction.

The *maison à sec* and the steel frame

At the end of the 1920s, French architects had begun to turn their attention to recent developments in metal construction. The first overt sign of this interest occurred in the spring of 1927, with the launching of the architectural competition for the design of metal-frame houses organized by the Société des Forges de Strasbourg.[139] During the following years a number of articles and publications focused on the potential role of metal in the development of French architecture.[140] A key figure in the promotion of reinforced concrete in French architecture, Le Corbusier was quick to investigate the territory opened up by the new interest in metal. Le Corbusier's first project based on metal construction involved the studies for the Maisons Loucheur in the fall of 1928,

138 Le Corbusier, "Un seul corps de métier", Almanach d'Architecture Moderne (see note 89), p. 109: "Avant le ciment armé, tous les corps de métier sur place, pour faire une maison. Après vingt d'application du ciment armé, on peut rêver: un seul corps de métier sur place: le maçon."
139 Forges de Strasbourg, Concours pour la construction d'Habitations métalliques, Paris, April 1927 (Fonds Perret, 535 AP 315).
140 On this question, see chapter VII.

houses conceived in the context of the Loi Loucheur of July 1928.[141] The key characteristic of the Loucheur law was the provision of funds for housing construction accompanied with a financial arrangement that encouraged the ownership of new housing. Each of the Maisons Loucheur was conceived as a double house divided by a load-bearing party wall made of brick or rough stone, with the floor and roof of each cell supported by a steel pilotis (fig.115).

Le Corbusier's early studies for the Maison Loucheur were done in October 1928, after the competition organized by the Forges de Strasbourg and the exhibition of the projects in January 1928.[142] But Le Corbusier's interest in metal construction was not linked solely to these promotional activities. At the 1925 Art Deco exhibition he was sufficiently interested in the Maison Isotherme developed by the engineer Raoul Decourt to describe the system in the pages of the Almanach d'Architecture Moderne (fig.116).[143] Moreover, in 1927 Le Corbusier had experimented with metal structures in the construction of the double house at the Weissenhof exhibition.

Le Corbusier's interest in metal construction was closely linked to the concept of the *maison à sec*. According to Christian Sumi, the idea of combining steel and dry construction methods [*matériaux à sec*] was indebted to Le Corbusier's encounter with Edmond Wanner in 1927.[144] An industrialist from Geneva, Wanner became involved with Le Corbusier in the production of a *fenêtre en longueur* in metal.[145] This collaboration led to the studies of the Projets Wanner for Geneva in 1928, an adaptation

141 Le Corbusier, "Réflexions à propos de la loi Loucheur", La Revue des vivants, August 1928.
142 On Le Corbusier and the Maisons Loucheur, see Tim Benton, "La réponse de Le Corbusier à la loi Loucheur", Le Corbusier, une encyclopédie, Paris, Editions du Centre Georges Pompidou/CCI, 1987, pp. 236-239 (Published in English in AA Files, no. 7, September 1984.)
143 Le Corbusier (see note 89), p. 192.
144 Christian Sumi, "L'immeuble clarté et la conception de la 'maison à sec'", Le Corbusier à Genève 1922-1932, Lausanne, Payot, 1987, pp. 93-112. According to Reichlin, at the Weissenhof, Le Corbusier was asked to make dry-mounted houses. Bruno Reichlin (see note 131), p. 38.
145 In a letter to Le Corbusier dated 12 March 1928, Edmond Wanner denies the architect's request to collect royalties on the *fenêtre en longueur*. Christian Sumi, "Wanner (Edmond) (1898-1965)", Le Corbusier, une encyclopédie, Paris, Editions du Centre Georges Pompidou/CCI, 1987, p. 478.

of the Immeuble-villas to the constraints of metal construction.[146] Unlike projects promoted by the steel industry, such as the Forges de Strasbourg, Wanner's approach to metal construction derived from his experience in the locksmith's industry (*serrurerie métallique*). As Le Corbusier later said of the Wanner project, "The problem, until now conceived for execution in reinforced concrete, shifts to metal construction and is expressed by means of an up-to-date concept, the *maison à sec.*"[147] In September 1928 Wanner further encouraged Le Corbusier to study the adaptation of the maison Citrohan to construction in steel.[148] In fact, by the time of the first CIAM congress in June 1928 Le Corbusier was much involved in the technical and architectural transposition from reinforced concrete to steel construction.

Though not a member of the commission set up by Loucheur after the voting of the housing law in July 1928, Le Corbusier was personally invited to make architectural suggestions. The projects he presented to Loucheur in May 1929 were all based on the dry assembly of a steel structure for the two housing cells separated by a thick rough-stone wall.[149] According to Benton, the stone wall must be understood in light of the *Notice technique* published in April 1929 by the Commission technique de l'habitation.[150] The Commission insisted on the need to maintain a balance between the various French building enterprises. Le Corbusier was quite explicit about his building strategy. In the lecture given in Buenos Aires in October 1929 he declared: "Here is our small house type 'Loi Loucheur'. A party wall of bricks, stones, etc., that I call

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146 These projects were the outcome of Wanner's attempt to create building societies. The "contract" drafted by Wanner was sent to Le Corbusier and Pierre Jeanneret the 1st of April 1928.

147 Le Corbusier, Jeanneret, Oeuvre complète 1910-29 (see note 81), p. 180: "Le problème envisagé jusqu'ici pour être réalisé en ciment armé passe à la construction métallique et s'exprime par une conception de la plus haute actualité, celle de la 'maison à sec'."

148 Benton (see note 142), p. 239.

149 Benton (see note 142), p. 238. According to Benton, it is the adaptation of the Citrohan project and of the first version of the maison minimum for the CIAM Congress (first conceived for reinforced-concrete construction) that was to be the source of the Maisons Loucheur.

150 Benton (see note 142), p. 238.

diplomatic because it seals the alliance with the local swindler."[151] In the Oeuvre complète, Le Corbusier was later to write that this strategy derived from his experience at Pessac, and was designed to counteract the influence of the local entrepreneur.[152] For Le Corbusier, one impact of the Loucheur law was that building corporations were tempted to raise their prices. This pressure from the building industry occurred at a time when the steel industry was in crisis.[153] Steel construction thus appeared to be a logical choice: "On the other hand, the steel industry is in crisis (it is said: at 50% of its production capacity).... With metal construction", Le Corbusier noted,"we should be able to obtain the prices we want."[154]

Both the Wanner and the Loucheur projects were based on the same type of structure. Posts and beams were made from two channels assembled back to back. In the Projets Wanner, the metal skeleton did not function in the architectural qualification of the building: "the concealment of the metal structure indicates that the principle of dry construction is subordinated to the search for of a purist spatiality."[155] In the perspectives of the Maisons Loucheur, however, Le Corbusier highlighted the tectonic and spatial quality of the vertical supports.[156]

Despite his new interest in metal construction and *construction à sec*, Le Corbusier did not see these as a universal solution. In 1929, he noted that the program of the *maison à sec* was mostly geared towards the single-house market and could not be

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[151] Le Corbusier, "Les techniques sont l'assiette même du lyrisme", in Précisions..., Paris, Crès, 1930, p. 46: "Voici notre type de petites maisons 'Loi Loucheur'. Un mur mitoyen en briques, pierres, etc. que j'appelle diplomatique car il scelle l'alliance avec le margoulin de l'endroit (des expériences que j'évoquerai une autre fois nous ont incités à faire alliance diplomatique avec le margoulin)."

[152] Le Corbusier, Jeanneret, Oeuvre complète 1910-29 (see note 81), p. 199: "Toutefois, l'expérience de Pessac a conduit à un petit stratagème de diplomatie opportune: il est prévu la construction d'un mur d'appui de la maison ou d'un mur mitoyen entre deux maisons, en maçonnerie de moëllons, de briques ou d'agglomérés, matériaux du pays, réalisé par le maçon du pays. Et ainsi, le noir complot de l'entrepreneur local sera déjoué et l'alliance utile scellée."

[153] A crisis confirmed by a reviewer of the Revue foncière et immobilière, October 1929.

[154] Le Corbusier, letter dated 12 May 1929: "Par ailleurs, la sidérurgie est en crise (on dit: le 50% de sa capacité productive)... Côté métallique nous obtiendrons les prix." Cited in Benton (see note 142), p. 238.

[155] Sumi (see note 144), p. 101: "la dissimulation presque complète de l'ossature métallique atteste le caractère subordonné de la conception constructive 'à sec' par rapport à la recherche prioritaire d'une spatialité puriste..."

[156] Sumi (see note 144), p. 101.

generalized for all types of construction, pointing to the need to consider reinforced-concrete construction as well.[157] In his contribution that year to the second CIAM congress on the Maison minimum, Le Corbusier further stressed that steel and reinforced concrete could both be counted on to fulfil completely the load-bearing function of the house frame. Arguing that the ideal solution was based on the frame, and consequently on the *plan* and *free facade*, he added that concrete could be used for large buildings and iron for small single houses built with dry construction methods.[158]

This intervention indicates Le Corbusier's shift from reinforced-concrete to steel construction for the industrialized house: choice of system now depended on the size and type of building. But his interest in metal construction went beyond the specific domain of the Maison minimum. From 1929 onward Le Corbusier often conceived his projects in terms of metal construction. In fact, projects studied in terms of one system were often shifted to the other. The Cité de Refuge (1929-33) in Paris was conceived and built in reinforced concrete, but the Swiss Pavilion (1930-33) in Paris and the Immeuble Clarté (1930-32) in Geneva, promoted by Wanner, were both conceived in terms of metal construction and *montage à sec*. It is only in subsequent studies that the steel posts that lifted the Swiss Pavilion from the ground were replaced by reinforced-concrete pilotis (fig.117). For the Immeuble rue Nungesser-et-Coli (1931-34) in Boulogne, Wanner apparently proposed to use a steel frame similar to that of the Immeuble Clarté, but a solution in reinforced-concrete was finally adopted.[159]

Conclusion

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[157] Le Corbusier, "Janvier 1929", L'Architecture vivante, Le Corbusier and Pierre Jeanneret, 2nd serie, Paris, Morancé, 1929, p. 10: "Le programme de la 'maison à sec' (qui répond à l'innombrable marché de la maison isolée) n'entend pas être généralisé à toute la construction; les problèmes d'ensemble se réaliseront aussi bien en ciment armé... "
[158] Le Corbusier, Pierre Jeanneret, "Analyse des éléments fondamentaux du problème de la Maison minimum", Die Wohnung für das Existenzminimum, 2nd CIAM congress, Frankfurt, Englert and Schlosser, 1930. Also published in La Revue de l'Habitation, vol. 25, no. 106, December 1929; vol. 26, no. 107, January 1930.
[159] Sumi (see note 145), p. 478.

The formulation of the Five Points stands both at the end and at the beginning of a conceptual process that focused on the definition of the architectural consequences of the concrete frame. Rooted in Le Corbusier's experience with reinforced-concrete construction, the Five Points were the conclusion of the architect's technical and aesthetic experimentation with the modern house. The Five Points also came at the beginning of a process that saw the extension of the constructional and aesthetic principles from the house to larger-scale projects, and the reintroduction of the metal frame as a key element in the development of modern architecture.

The integration of the steel frame within Le Corbusier's theory and practice reveals an approach to materials that severed ties with the tenets of Rationalist thinking. Though concerned with the broad relation between structure and form -- a relation theorized by Viollet-le-Duc and his followers -- Le Corbusier examined the consequence of this relation in terms of architectural elements (pilotis, windows, modern walls, flat roof) and their structural articulation (free plan, free facade). In his projects of the late 1920s, the change from the reinforced-concrete to the metal frame triggered a change in mode of production but not in architectural forms. The shift in building system did not generate a change in his aesthetic principles.

Though reinforced concrete was at the origin of Le Corbusier's reflections on the new architecture, the material was merely a necessary step in the search for the industrialization of construction. Contrary to Perret, Le Corbusier did not locate the modernity of reinforced concrete in the material itself, but rather in the *système de structure* it allowed. With Perret, constructional truth was located in the visual expression of the structural material. With Le Corbusier, truth of construction was to be found in the logic of the *système de structure*. That *système* led to the development of a new tectonic language that, overcoming the conventions of nineteenth-century Rationalism, integrates the structural frame within a larger plastic system.

3. French Criticism and the early Historiography of French Modernism (1928-30)

In Les tendances de l'architecture contemporaine published in 1930, Myron Malkiel-Jirmounsky -- a professor at the Université de Paris -- proposed his interpretation of the most recent trends in modern architecture.[160] Now mostly forgotten, Jirmounsky's book was one of the few contemporary texts that attempted to present and explain the differences between the various architectural approaches adopted during the late 1920s in France. It offered one of the first retrospective readings of the new architecture in light of the distinctions introduced by the works and ideas of Auguste Perret and Le Corbusier. Different from the apologetic articles that originated from Perret's circle, Jirmounsky's book proposed an account of the state of modern architecture that moved from criticism to historiography.

Jirmounsky and the two trends of French modernism

The position defended in the book had already been articulated in two articles published in 1928. The first was published in the Bulletin du Redressement Français,[161] the second in L'Amour de l'Art.[162] Set up by a political organization who sought to overcome the flaws of contemporary politics by enlightened industrial production, the Bulletin had just published a few articles by Le Corbusier, who then shared this ideological position.[163]

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160 Myron Malkiel-Jirmounsky, Les tendances de l'architecture contemporaines, Paris, Librairie Delagrave, 1930.

161 M. Malkiel-Jirmounsky, "Réflexions sur l'architecture contemporaine III. La France", Supplément au Bulletin du Redressement Français, 1 September 1928, pp. 1-4 (Fonds Perret, 535 AP 323).

162 M. Malkiel-Jirmounsky, "Tendances de l'Architecture contemporaine", L'Amour de l'Art, vol. 9, no. 10, October 1928, pp. 361-371.

163 In 1928, three articles by Le Corbusier were published in the Supplement of the Bulletin du Redressement Francais: "Vers le Paris de l'époque machiniste" (February 1928); "Pour bâtir: standardiser et tayloriser" (May 1928); "Pourra-t-on bientôt se loger? Une enquête sur la loi Loucheur" (September 1928). In May 1928, the Bulletin began publishing a series of articles addressing contemporary problems of architecture and urbanism. On the "Redressement Français", see Mary McLeod, "'Architecture or Revolution': Taylorism, Technocracy, and Social Change", Art Journal, Vol. 43, no. 2, Summer 1983, pp. 142-143.

Likely a member of one of the committees set up by the "Redressement Français", Jirmounsky may have been in contact with Le Corbusier.[164] By contrast, L'Amour de l'Art clearly defended a position favorable to Perret's work and ideas.[165] But Jirmounsky himself was not a member of Perret's circle.[166] The one common denominator of the two journals was their commitment to the national interest, whether it be artistic or economic.

While the article in the Bulletin focused on the French situation, the text published in L'Amour de l'Art was broader in scope, placing French architecture in the context of other architectural cultures. From the outset, Jirmounsky argued that the new architectural style was a universal style, an expression of aesthetic principles current everywhere.[167] Jirmounsky grounded his analysis of the trends of contemporary French architecture in a broad historical assessment of artistic developments. According to Jirmounsky, two contrary tendencies were at play in the history of artistic forms. The first trend was called Static art, identified with classic art, embodied in buildings of tectonic honesty, and exemplified by Greek and Renaissance works. The second was called Dynamic art, identified with romantic art, and exemplified by Gothic and Baroque works.[168] "From the ideological point of view", Jirmounsky wrote, "this architecture is a synthesis of the two contrary tendencies that have succeeded over the centuries in the historical evolution of artistic creations."[169]

Merging this theoretical framework with the contemporary preoccupation with building materials, Jirmounsky argued that contemporary developments in French

164 The "Redressement" enlisted various "men of action" -- journalists, lecturers, professionals -- to contribute to the Bulletin or to participate in its study committees. Le Corbusier was enlisted to participate on an urban study committee. McLeod (see note 163), p. 142.

165 With the contributions of Marie Dormoy and Marcel Mayer, L'Amour de l'Art had been a forceful defended of Perret's ideas and architecture since 1923.

166 In a letter to Auguste Perret dated 12 December 1928, Malkiel-Jirmounsky introduces himself, and writes that he would like to meet the architect personally (Fonds Perret, 535 AP 318).

167 Jirmounsky (see note 162), p. 361: "Le caractère organique et synthétique du style monumental qui se crée à nos yeux, est d'autant plus remarquable que ce style est un style universel,-- expression des mêmes principes esthétiques sous toutes les latitudes."

168 Jirmounsky (see note 162), p. 362.

169 Jirmounsky (see note 162), p. 362: "Du point de vue idéologique cette architecture est une synthèse des deux tendances contraires qui se succèdent à travers les siècles dans l'histoire de l'évolution des créations artistiques."

architecture had to be understood in terms of the possibilities offered by reinforced-concrete construction: "The new artistic movement has as a primary condition the new matter, the new materials -- the result of new economic conditions, of the social necessity of obtaining the most economical housing possible. One can say that construction in concrete and reinforced cement has triggered a revolution in architectural aesthetics."[170] Concrete had triggered an aesthetic revolution, Jirmounsky argued, because the material was adaptable to all constraints and could assume forms unknown until then, encouraging the exploitation of light and shadow. Jirmounsky chiefly stressed the formal potential of reinforced concrete, ignoring the contemporary interest in the industrialization of construction.

France's leading role in the revolution triggered by reinforced concrete was easy to explain. For Jirmounsky, the key 'material' was a French invention -- a reiteration of the position advanced at the turn of the century and currently promoted by the Perret circle. Moreover, it was in France that the new 'material' had been used for the first time with a clear awareness of its plastic and modern possibilities, a development due to the Perret brothers. It was France, therefore, that offered the most radical and most logical solution to the architectural problems of the era.[171]

In his search for precedents, Jirmounsky proposed the connection between nineteenth-century iron construction -- naming Labrouste, Coquart, Dutert, Eiffel as the key protagonists -- and the early essays in concrete construction made by Anatole de Baudot. For Jirmounsky, the new movement was the logical outcome of the ideas put forth by Viollet-le-Duc (1864) and Van de Velde (1892) in the nineteenth century, and was represented in France by the Perret brothers (the *doyens* of the new school), Le Corbusier, Mallet-Stevens, Tony Garnier, Lurçat, and a few others. The key

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170 Jirmounsky (see note 162), p. 363: "Le nouveau mouvement artistique a pour condition la nouvelle matière, les nouveaux matériaux -- résultat du nouvel état économique, de la nécessité sociale d'avoir les moins coûteuses habitations possibles. On peut dire que la construction en béton et ciment armé a provoqué la révolution de l'esthétique architecturale."

171 Jirmounsky (see note 162), pp. 365-366: "Parmi ces solutions du problème architectural de notre époque, c'est en France que nous trouvons la plus radicale, la plus nette, la plus logique."

characteristic of this school was a commitment to the exploitation of reinforced concrete.[172]

For Jirmounsky, the new school was not united but rather divided into two diverging trends. The first (the oldest and more moderate) developed forms that were more rooted in tradition. Identified with the Perret brothers, this trend was concerned with tectonic honesty: it insisted that constructional elements be left visible.[173] The second trend, identified with the younger generation, preoccupied rather with "the nudity of the large surfaces, the negation of any decorative motif, the play of full volumes, the spaces, the plastic qualities of the new material".[174]

For Jirmounsky, three distinct attitudes could be identified within the younger generation, in the works of Le Corbusier, Mallet-Stevens, and Tony Garnier. The architecture of Le Corbusier was presented as the most forceful adaptation of the house to the requirements of modern life. Its sober exterior forms are defined by plane surfaces, the straight line, and unitary facades. The load-bearing walls are replaced by light membranes interrupted by rows of windows that play an active role on the flat surface of the walls. Though inspired by similar ideas on modern living, the architecture of Mallet-Stevens is endowed with different forms. Here, the expression of external forms dominates, in the play of cubes and cylinders. Distinct from these, the architecture of Tony Garnier is identified by the elimination of all decorative elements, by the unity and sobriety of structures, by the pure lines of volumes. The dominance of grand horizontal and vertical lines gives Garnier's public works an appearance of calm and nobility.

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[172] Jirmounsky (see note 162), p. 366: "Cette école adopte jusqu'en ses conséquences les plus rigoureuses, l'idéologie de l'art nouveau et utilise parmi les matériaux de construction à peu près exclusivement le béton."

[173] Jirmounsky (see note 162), p. 369: "Son principe est l'apparence marquée des éléments de la 'constructivité'; -- le style--, je dirais presque le style d'ingénieur, -- dépend entièrement de la matière choisie, des dispositions des axes de la construction. Par honnêteté tectonique les éléments constructifs sont laissés visibles, aussi bien que les directions des forces constituantes du monument."

[174] Jirmounsky (see note 162), p. 369: "L'école des jeunes (...) se préoccupe avant tout ici, comme ailleurs, du problème de la nudité des grandes surfaces, de la négation démonstrative de tout motif décoratif, du jeu des volumes entiers, des espaces, des qualités plastiques du nouveau 'matériau'."

Jirmounsky was careful to distinguish between the design approach of each architect. Le Corbusier designed from the inside out, viewing the external forms as the sober projection of the internal architecture. Mallet-Stevens' approach was somewhat the contrary, understood as an aesthetic based on the expression of external forms. It was an analysis largely indebted to a formal not a constructional reading of the works, an emphasis further revealed by Jirmounsky's identification of Garnier's work with radical trends of the younger generation. By the end of the 1920s, Garnier was increasingly seen as a precursor of the new French architecture.[175] If Jirmounsky made this association, it was by focusing on his search for pure volumes, naked surfaces, and the plastic qualities of the material. Oblivious to the technical and compositional differences that actually distinguished Garnier's architecture from that of the younger generation (wall making, window openings, etc.), Jirmounsky insisted on the formal appearance of French modern architecture.

Critical sources

In L'Amour de l'Art, Jirmounsky introduced his analysis of contemporay French architecture through an opposition between the Static and Dynamic arts, two contrary tendencies present through centuries of the historical evolution of artistic creations. Describing the two schools of French modernism, Jirmounsky opposed Perret's emphasis on the visibility of constructional elements to Le Corbusier's search to express the plastic qualities of the material. In this respect, Jirmounsky's theoretical framework recalled the historical and critical categories proposed by members of the Perret circle. In his contributions to L'Amour de l'Art, Mayer had framed contemporary French architecture in light of the opposition between classicism and romanticism, bringing the practice of French architects identified with international modernism under the banner of

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[175] Pierre Bourdeix, "Tony Garnier. Précurseur de l'Achitecture d'Aujourd'hui", L'Architecture d'Aujourd'hui, no. 4, March 1931, pp. 33-35.

romanticism.[176] For Mayer, the architects associated with classicism were deeply concerned by construction, while architects associated with romanticism were solely concerned by plastic research. In an article of 1927 on Mallet-Stevens, Dormoy introduced the distinction between the *architectural* and the *plastique*.[177] Again in 1930, in an article on Le Corbusier, Dormoy decisively framed the two trends of French modernism in light of the distinction between the *constructif* and the *plastique*.[178] Unlike Mayer's recourse to established historical categories, Jirmounsky's distinction between the Static and Dynamic arts did not imply value judgement. However, like Mayer and Dormoy, Jirmounsky framed the distinction between Perret and Le Corbusier in terms of the formal opposition between tectonic and plastic expression. The impact of modern materials on architecture had become a formal rather than technical influence.

On the critique of coating

In the article published in the Bulletin du Redressement Français, Jirmounsky raised the problematic issue of the use of a coating in modern building. After having stressed the visibility of the constructional elements in Perret's architecture, Jirmounsky wrote: "This visual treatment of the skeleton evades the disastrous cracks that will soon threaten buildings in concrete covered with a coating."[179] On the other hand, Jirmounsky was worried by the durability [*pérennité*] of the buildings put up by the younger generation. He wondered if the "large, beautiful, luminous surfaces" of these buildings would sustain the test of time without cracks. But for Jirmounsky, the issue was not only technical. He continued: "One wonders if this artificial nudity, created by means of a coating that conceals the true elements of the construction, is not by itself an added

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176 Mayer (see note 21); see also: Marcel Mayer, "Introduction", in A. & G. Perret (Les Albums d'Art Druet), Paris, Librairie de France [c. 1928], n.p.

177 Dormoy (see note 18), p. 378.

178 Marie Dormoy, "Le Corbusier", L'Amour de l'Art, vol. 9, no. 5, May 1930, pp. 213-218.

179 Jirmounsky (see note 161), p. 2: "Cette ossature respectée et soulignée permet d'éviter les désastreuses marques de fissures qui menacent, dans un avenir prochain, les monuments en béton couvert d'enduits."

decorative element, and if this element found everywhere is legitimate from the point of view of 'honesty', a key idea of the new movement."[180] Since these large bare surfaces concealed the constructional elements of the building, was bareness not itself a decorative element?

Jirmounsky's reading of the impact of coating in contemporary architecture was largely indebted to the interpretation developed by Perret and his circle. In a critical comparison between Perret's work and the architecture of the modernists, Marcel Mayer wrote in L'Amour de l'Art: "But the true architectural beauty is so foreign to the romantics that they conceal without remorse one of the most beautiful organs of the construction under a coating or a roughcast covering."[181] Drawing on the anatomical analogy, he argued that the romantics were concerned merely with the skin, not the structure and the muscles of the built organism. "And thus disappear", Mayer complained, "the loyal and honest materials which are to the architect what colors are to the painter."[182]

Critical reflections on the use of coating in architecture were not uncommon in French architectural culture of the 1920s. These reflections could be related to the Beaux-Arts critique of the Italian tradition.[183] But the first writer to comment on the use of coating in French modern architecture did not primarily understand it in terms of concealment. In 1925, Louis Hautecoeur -- a critic of Beaux-Arts affiliation -- raised this issue in his review of the new architecture published in the context of the Congrès des Architectes Français. Hautecoeur wrote: "In some *hôtels particuliers* built by the young

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180 Jirmounsky (see note 161), p. 3: "On se demande si cette nudité un peu artificielle, créée au moyen de l'enduit cachant les vrais éléments de la construction, n'est pas un élément décoratif *sui generis* ajouté, et si cet élément introduit partout est légitime du point de vue de la "sincérité", idée maîtresse du nouveau mouvement."

181 Mayer (see note 21), p. 84: "Mais la véritable beauté architecturale leur est si étrangère qu'ils dissimulent sans regrets sous des enduits ou des crépis badigeonnés l'un des plus beaux organes de la construction."

182 Mayer (see note 21), p. 84: "Ainsi disparaîssent les probes matériaux qui sont cependant à l'architecte ce que les couleurs sont au peintre."

183 According to Pierre Saddy, the critique of coating proffered by Perret and his circle derived from their rejection of the Italian tradition. P. Saddy, "Perret (Auguste) (1874-1954)", Le Corbusier, une encyclopédie, Paris, Editions du Centre Georges Pompidou/CCI, 1987, p. 300.

architects, the construction is concealed behind a roughcast, and one is tempted to find their Spartan sobriety a little ostentatious. In fact, their houses made of bricks, of rubble stone, of agglomerate imitate the rigid forms of reinforced concrete. These young architects know that this material [reinforced-concrete] would be too expensive for these small buildings, but they give in to the fashion of the day."[184] Hautecoeur's reading of the mid-1920s derived from an analysis of models and a few executed modern houses. He repeated this interpretation in his later writing.[185] For Hautecoeur, what the coating concealed was not the reinforced-concrete structure -- absent in most buildings -- but the masonry nature of constructions that imitated the rigid forms of reinforced-concrete construction. For Hautecoeur, coating was used for its potential for imitating the architecture of reinforced-concrete construction, not to conceal it.

Contrary to Hautecoeur, Perret and his circle articulated the critique of coating in terms of the doctrine of the truth of materials. Having abandoned the use of coating in his house projects conceived after 1926, Perret could accuse the modernists of concealing the nature of both the material and the construction system adopted. Though Perret rejected the use of coating on the basis of a technical argument, the fundamental motivation behind this critique was doctrinal and ideological. It is only after having abandoned the use of coating in his own projects that Perret rejected its use in architecture as an operation of concealment. Perret used coating in the maison Gaut in Paris and the maison Mouron in Versailles, a use later justified on the basis that these houses had no concrete skeleton. The technique of coating was suggested in his mass-housing project published in L'Esprit Nouveau and effectively used in his workers' house at Grand Quevilly, in this latter case apparently using a mixed system of brick masonry walls and concrete posts.

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184 Louis Hautecoeur, in L'Architecture, 1925: "Dans certains hôtels particuliers bâtis par de jeunes architectes, la construction se dissimule derrière un crépi et parfois on serait tenté de juger leur sobriété spartiate quelque peu ostentatoire. En fait leurs maisons de briques, de moellons ou d'agglomérés imitent les formes rigides du ciment armé. Ces jeunes architectes savent bien que ce matériau serait trop coûteux pour de petits édifices, mais ils cèdent à la mode du jour."

185 Louis Hautecoeur, Considérations sur l'art d'aujourd'hui, Paris, Librairie de France, 1929.

In the years that followed Perret continued to be critical of the use of coating.[186] Yet by then the technical argument was clearly subsumed under a broader aesthetic issue: the role of ornament in modern architecture. Superseded by other considerations during the first half of the 1920s, this issue reappeared in architectural discourses during the second half of the decade. In 1927, the critic Ernest Tisserand could argue that modern architecture had not suppressed the need for ornament.[187] Though Perret's conception of ornaments differed from that of Tisserand, he still construed the ornament as a valid category in the debate on the new architecture, arguing (as Jirmounsky would repeat) that the nudity of the new architecture was itself an ornament. In a lecture given in 1931, Perret read the bare forms of the new architecture as decorative: "To fashion a bare form they conceal the essential parts of the construction, like the posts and beams, behind a coating: as if, treated in this way, the bare form did not become an ornament: an ornament that settling and expansion will rapidly jeopardize, revealing through the cracks the essential organs they wanted to conceal."[188] Commenting further on the possibility of developing a type of coating that would not crack, Perret confidently claimed that "luckily, this coating will never be found."[189] Crossed out in the manuscript of the lecture, this passage betrays the architect's doctrinal opposition to the use of coating.

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[186] See Auguste Perret in "Vers un style nouveau en architecture...", L'Intransigeant, 21 June 1930. Perret declared: "Aussi, pourquoi ces enduits extérieurs, tout ce toc que j'appellerai des cache-misère? L'enduit finit toujours par tomber, dévoilant les secrètes laideurs. Construisons avec des matériaux pauvres, s'il le faut, mais toujours apparents."

[187] E. Tisserand, "L'évolution de l'architecture moderne", L'Art et les Artistes, vol. 14, no. 76, April 1927, pp. 238-245. He wrote: "Car l'ornement n'est pas mort, la ligne droite et le cube ne l'ont pas tué. L'anathème que lui a lancé Le Corbusier n'a pas suffi à le détruire" (p. 243) -- "Qu'il ait été utile, pour un temps, de proscrire l'ornement des oeuvres inspirées par les théories 'modernistes', cela ne se discute pas" (p. 243) -- "La question de l'ornement est une de celles qui divisent actuellement les architectes 'modernes'". (p. 244).

[188] A. Perret, original untitled manuscript of the lecture given in Amsterdam, 3 February 1931, p. 43 (Fonds Perret, 535 AP 328): "Pour faire un beau nu ils dissimulent derrière des enduits les parties essentielles de la construction, tels que poutres et poteaux: comme si, traité de cette façon, le NU ne devenait pas un ornement: ornement bien vite compromis par le jeu forcé des tassements et des dilatations qui ne tardera pas à montrer par des fissures, les organes essentiels qu'on a voulu cacher."

[189] Perret (see note 188), p. 43. Perret's negative assessment of the technical performance of coating was formulated at the time of a major campaign for the use of a new industrial paint, called Stic B, that increased the resistance of cement surfaces. See "La Croisade pour la couleur et pour l'hygiène", Le Bâtiment illustré, 3rd serie, no. 2, February 1931, pp. 7-56.

By the end of the 1920s, Perret's interpretation of coating as concealment was widespread, becoming a key argument in the critical contributions of his followers. It also became an issue for architects and critics not affiliated with Perret's circle. In a book on the developments of new ideas in construction and forms in French architecture, Roger Ginsburger raised this issue in his discussion of modern architecture.[190] Ginsburger wrote: "Today, Perret criticizes the buildings designed by younger architects for being badly built and having ornaments for form (the only forms are ornaments). The load-bearing framework and the curtain walls cannot be indiscriminately covered with the same plaster. The error of this building method becomes clear when, after a few years, the curtain walls separate from the structure, and cracks appear in the plaster."[191] Yet he also added: "This formal constraint and this principle of 'showing' the structure are the limitations of Perret's own creations."[192]

Coating as masking

By the end of the 1920s, the concealment of the skeleton and its constituent material had become a key argument in the critique of modern architecture in France. The conception of coating as concealment has had a long-life. In most recent studies concerned with the architecture of the 1920s in France, the use of coating in domestic architecture is presented as a practice aimed at concealing the traces of construction. In his study on André Lurçat, Jean-Louis Cohen uses the term "masking" to describe the function of the coating applied to both the concrete floors and the load-bearing masonry walls of the Lurçat house.[193] In a recent study on the principle of the revetment in modern

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[190] Roger Ginsburger, Frankreich. Die entwicklung der neuen ideen nach konstruktion unf form, Vienna, Anton Schroll & Co., 1930. For an abridged version in English, see: Roger Ginsburger, "France. The Development of New Ideas in Construction and Form", Rassegna, no. 38, June 1989, pp. 68-87.

[191] Ginsburger (see note 190), p. 76.

[192] Ginsburger (see note 190), p. 76.

[193] In his analysis of the house designed by André Lurçat for his brother, Cohen writes: "L'hétérogénéité constructive des murs porteurs en maçonnerie et des planchers en béton est masquée par l'enduit blanc général sur lequel se détachent l'auvent des entrées et la jardinière de l'atelier". Jean-Louis Cohen, André Lurçat 1894-1970. Autocritique d'un moderne, Paris-Liège, IFA-Mardaga, 1995, p. 32.

architecture, Giovanni Fanelli and Roberto Gargiani take up the notion of mask to describe the external treatment of Le Corbusier's double house La Roche-Jeanneret.[194] In these studies, masking is most often perceived as a deliberate attempt to conceal the construction, echoing the interpretation sustained by Perret and his circle during the late 1920s, and thus giving credit to an interpretation that was itself the outcome of a doctrinal criticism of modernism.

The issue of coating as masking -- and the corollary interpretation of broad naked surfaces as a new form of ornament -- is forcefully argued in a recent critical study on modern architecture. In the book White Walls, Designer Dresses, Mark Wigley explores the relation and ultimate submission of modern architecture to the ideology of fashion.[195] The author develops his argument based on the analysis of a key feature of modern architecture: white walls. "Although the white wall exemplifies the stripping away of the decorative costumes worn by nineteenth-century buildings," Wigley "argues that modern buildings are not naked. The white wall is itself a form of clothing -- the newly athletic body of the building, like that of its occupants, wears a new kind of garment."[196] It is the construal of coating as a practice of concealment that allows Wigley to develop a theory of the white wall as a kind of modern dress. Wigley denies that Le Corbusier took any interest in the structure of buildings. The only conspicuously designed structural skeleton -- the Dom-ino house -- is read as a mere prop that acquires its significance through its mode of dressing, understood in Semperian terms.[197] According to Wigley, Le

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[194] Giovanni Fanelli, Roberto Gargiani, Il principio del rivestimento, Rome-Bari, Laterza, 1994. "Negli hôtel particulier Raoul La Roche-Albert Jeanneret (1923-25), prima importante architettura purista di Le Corbusier, il ritmo calcolato della disposizione delle aperture sembra indicare l'esistenza della trama regolare di campate di quella struttura in calcestruzzo armato così esaltata sulle pagine dell'"Esprit Nouveau" da farne la ragione stessa della nuova architettura; in realtà è proprio la **maschera d'intonaco** a rendere omogenea una seria di esili montanti realizzati in calcestruzzo armato e in muratura, secondo un progetto strutturale che dimostra una totale (si pottrebbe anche dire "viennese") indifferenza alla logica del moderno telaio." (p. 263)

[195] Mark Wigley, White Walls, Designer Dresses: The Fashioning of Modern Architecture, The MIT Press, Cambridge, 1995.

[196] Wigley (see note 195), front flap.

[197] Wigley writes: "The building system, which rationalizes structure in such a way that all walls become at most light screens, if not curtains, drawn, more or less, across the openings, is a fundamentally Semperian system in which structure is merely the technologically refined but secondary

Corbusier was interested in the dress, not the structure of modern architecture. Understood as such, coating is masking, clothing, fashion.

For Wigley, the whitewash of Le Corbusier's *Loi du Ripolin* epitomizes the material coat that makes the white wall. In this interpretative framework, "whitewash" is indifferently assimilated with a coating of [lime] whitewash, white paint, or cement. But Wigley does not discuss the technique of the coating, of the mask. But for a concrete and masonry wall to be fully masked, the coating used had to have a certain thickness. Over the years, Le Corbusier experimented with different techniques of wall construction, from the cement-gun walls of Pessac to the masonry walls of the Weissenhof houses. Moreover, the architect used different coating techniques, different systems to cover and seal the structure and the masonry infill. While seeking to demonstrate that the white wall is itself a form of clothing, Wigley tends to ignore the very materiality of Le Corbusier's white walls.[198] Examining Le Corbusier's and Lurçat's ideas and practice related to the use of coating, I argue that the practice, function and meaning of the "white wall" changed during the 1920s. And that if the idea of "white walls" is to be understood in terms of the fashion discourse, its practice can only be understood in light of the early 1920s experience of reinforced-concrete construction.

Coating in French modernism: theory and practice

In early 1923, Le Corbusier called for the purification of architecture. To achieve this goal, he called for the whitening of architecture: "It is a necessity that is moral rather than material. One should establish the law of whitewashing."[199] The cleansing Le Corbusier

pop, a scaffolding for thin surfaces hung like textiles to define social space." Wigley (see note 195), pp. 186-187.

[198] According to Wigley, Le Corbusier "ultimately gives up on the white exterior surfaces only because he lacks the technical control to avoid cracks -- cracks that completely subvert the status of the surface by revealing that it is but a coat." Wigley (see note 195), p. 116. Giving credit to the technical argument raised by Perret against the use of coating, Wigley seems to undermine the logic of his own argument. To pursue his demonstration on the rhetoric of fashion in modern architecture, Wigley should rather focus on changes in Le Corbusier's conception of dressing, of clothing.

[199] Le Corbusier stated: "Et c'est là une nécessité morale plus encore que matérielle. Il faudrait établir la loi du blanchiment. Cette propreté fait voir les objets dans leur vérité sincère: d'où l'obligation d'une

sought in the whitening of architecture was to help see objects in their sincere truth. At the end of 1923, Le Corbusier further insisted on the visual purification that could be achieved if the house were all white. "If the house is all white, the contour of things is highlighted; the volume of things appears clearly: the color of things is categorical. Whitewash is absolute.... Whitewash is extremely moral."[200] Evoking the morality of whitewash, Le Corbusier was not addressing the materiality but the symbolism of the surfacing material. Whitewash was taken in the figural not the technical sense; the issue was not material but moral.

But with the construction of his first modern houses, Le Corbusier was naturally to turn to the use of a material surfacing that could fulfil the technical requirements of concrete and masonry construction. At the villa Besnus, the masonry wall was made of terracotta bricks 11 cm thick on the outside, plaster panels 5 cm thick on the inside, with a space of 7 cm in between. As the contract specified, both frame and wall infill were to be covered with a homogeneous coating of *lithogène*, or of "any external revetment that could resist freezing, not be porous, and render the quality of stone".[201] *Lithogène* was a special coating made of alabaster plaster and stone powder that sealed the masonry wall and gave it the textural quality of stone. The maison Gaut built by Perret was also coated with *lithogène*. The load-bearing masonry wall made of bricks supported the concrete slabs, which also served as lintels. The coating sealed and unified the heterogeneous surface of a wall made of both bricks and horizontal concrete elements. Both Le Corbusier and Perret sought the protective and textural quality of *lithogène* for the finish of their modern houses. *Lithogène*, which was also called *ciment-pierre*, was different

pureté parfaite. Retenons le terme: il définit toute une discipline. Il implique une certaine nudité." Le Corbusier, in Guillaume Janneau, "L'Exposition des arts techniques de 1925. IX. - Que sera demain le logis?", Bulletin de la Vie Artistique, vol. 4, no. 3, 1 February 1923, pp. 64-65.

200 Le Corbusier, "Salon d'Automne: architecture", L'Esprit Nouveau, no. 19, December 1923, n.p.: "Si la maison est toute blanche, le dessin des choses s'y détache sans transgression possible; le volume des choses y apparaît nettement: la couleur des choses y est catégorique. Le blanc de chaux est absolu, tout s'y détache, s'y écrit absolument, noir sur blanc; c'est franc et loyal... Le blanc de chaux est extrêmement moral."

201 Contract with G. Summer, 23 April 1923 (FLC H1-9-44): "les enduits extérieurs en lithogènes ou toute autre matière analogue reconstituant la pierre et résistant parfaitement au gel et n'étant pas poreux."

and substantially thicker than whitewash. It was not used to conceal but to seal and unify the heterogeneous materials of the masonry construction.

With the projects for Lège and Pessac (1924-26), Le Corbusier experimented with a different technique of wall construction. The walls were to be built with the Cement Gun. The cement was sprayed on the reinforcement and the formwork set between the structural frame. In such a system, sprayed cement was not used to conceal but to constitute the wall envelope, dispensing with the need for an external revetment.

In the double villa La Roche-Jeanneret (1924-25), Le Corbusier returned to the more traditional technique of wall construction. Le Corbusier exploited all the resources of the mixed construction system to generate the structure of the house. Masonry works were used for the production of continuous wall surfaces, erasing the distinction between load-bearing and non load-bearing walls. Reinforced-concrete elements -- posts, beams, lintels, etc. -- were duly exploited to facilitate the confection of these planar partitions. The impression of material continuity was emphasized by means of a uniform coating both inside and out. In this project, Le Corbusier planned to use two different qualities of coating, distinguishing the front from the back of the house.[202]

Wigley points to the before and after images of the villa La Roche published by Sigfried Giedion in a 1927 issue of Der Cicerone (later published in Bauen in Frankreich. Eisen. Eisenbeton), arguing that "Le Corbusier himself never publishes such revealing images" (fig.118).[203] For Wigley, these images "demonstrate the extent to which the machine age finish of white-painted stucco is but a 'look' that veils the basically handcrafted structure beneath."[204] He adds that Badovici would do the same thing with images of the villa Savoye in a 1931 issue of L'Architecture Vivante. For Wigley, these

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[202] The tender by Kuntz & Pigeard specifies that *lithogène* was to be used for the garden (back) facade, while a coating of cement and lime water was to be used for the street facade and lateral party walls. The adoption of a cement coating might indicate Le Corbusier's desire to increase the abstract quality of the wall, a quality that could well have been hampered by the grainy texture of *lithogène*. Tender by Kuntz & Pigeard, Travaux Publics et Particuliers, 30 January 1924 (FLC H1-3-72/73).

[203] Wigley (see note 195), p. 116. For an analysis of Sigfried Giedion's book, see the Conclusion of this dissertation.

[204] Wigley (see note 195), p. 116.

images provide further proof that Le Corbusier "perfects the mask before perfecting the construction underneath, mastering the image of functionality before functionality itself."[205] For Wigley, Le Corbusier used the coating to hide and conceal the handcrafted character of the construction.

Wigley bypasses the photographs of the villa La Roche reproduced in the fall 1926 issue of L'Architecture Vivante (fig.119).[206] By then, Le Corbusier was acquainted with Badovici and the journal, and these images could not have been published without his consent. The images of the construction and of the finished project are not presented on the same plate, but appear on subsequent pages. Taking up only two of these images, it is Giedion who will emphasize the contrast of before and after. The images published in L'Architecture Vivante in fact fully reveal the positive function performed by the coating. Clearly rejecting the traditional conception of the envelope as a solid mass pierced by openings, Le Corbusier adopted instead a method of planar composition that gave equal status to open (windows) or closed (walls) partitions. The images show how the homogeneous coating permitted the architect to unify and connect interior and exterior. In this project, Le Corbusier gave the coating a new aesthetic function.

The use of coating in the definition of the new architecture was not theorized from the outset. It was rather the result of an integrative process that helped turn the practice into an aesthetic principle. The experience of Lurçat exemplifies this process. In 1924, André Lurçat presented a project for a group of studios for craftsmen. The studios were to be based on load-bearing walls built of hollow cement blocks. In an article of 1925, Lurçat described the external revetment of the constructions: "The exterior walls can be colored with a coat of whitewash which is easy to keep up and economical."[207] In this project, the whitewash finish was considered an economical complement to masonry

205 Wigley (see note 195), p. 116.

206 Jean Badovici, "Hôtel particulier, rue du Docteur-Blanche, à Paris, par Le Corbusier et P. Jeanneret", L'Architecture Vivante, vol. 4, no. 13, Fall 1926, pp. 15-16.

207 [André Lurçat], "Un groupe d'ateliers par André Lurçat", Clarté, January 1925 (Fonds Lurçat, 533 AP 004): "Les murs extérieurs se peuvent colorer au badigeon à la chaux, d'entretien facile et très économique."

walls made of cement block. Soon after, Lurçat was to begin to insert concrete-frame elements into the load-bearing masonry constructions. He was also to implement the use of coating on a large scale. At the Cité Seurat, all the studios and houses were covered with a white coating that unified the constructions. This coating gave the ensemble an overall whiteness often noted by critics.[208] Lurçat was also to exploit the possibilities offered by colored coating. According to a contemporary review of the *hôtel particulier* built in Versailles, the north and south facades of the house were colored sky blue, while the loggia was colored white to emphasize the contrast with the whole.[209]

It is at this time that Lurçat began to theorize the use of coating on the basis of the search for homogeneity. In a 1926 article, Lurçat insisted on the need to achieve the unity of plastic and constructional qualities: "It is important to stress the continuity of the instinct which leads French architects away from theoretical investigations and toward constructions uniting both plastic and structural values."[210] Lurçat continued: "We began to completely shed all decorative formulas and follow simply the nature of our materials. Inevitably, this brought with it the unity of appearance and simplicity of expression which are the fundamental basis of the development of a new plasticity."[211] In this quest for unity, Lurçat favored the homogeneity of the building's external aspect. This belief was most clearly expressed in a letter to Bruno and Max Taut, in which he criticized the "heterogeneity of materials" in architecture.[212] According to Jean-Louis Cohen, Lurçat's

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208 Charles Imbert, "Le quartier artiste de Montsouris, la Cité Seurat, 101 rue de la Tombe-Issoire (Paris)". L'Architecture, Paris, vol. 40, no. 4, 15 April 1927, pp. 101-112.

209 [Anonymous], "Hôtel particulier à Versailles (S.& O.)", L'Architecte, no. 10, October 1926, p. 80: "Les façades nord et sud sont colorées en bleu de ciel; la loggia est blanche afin de la laisser se détacher sur l'ensemble..."

210 André Lurçat, "L'architecture française; son bilan avant l'effort actuel: la tradition abandonnée depuis 1820, un siècle de perdu", 7 Arts, no. 5, 12 December 1926, p. 1: "Il faut insister sur la continuité de l'instinct qui porte l'architecte français, loin des recherches théoriques, vers des réalisations unissant les qualités plastiques aux qualités constructives."

211 Lurçat (see note 210), p. 1: "Tous nous avons commencé par nous dépouiller complètement de toutes formules décoratives, suivant seulement les matériaux qui amènent inévitablement l'unité d'aspect et la simplicité d'expression, bases nécessaires et rigoureuses pour l'avènement d'une plastique renouvelée."

212 André Lurçat, letter to Bruno and Max Taut, Paris, 17 January 1927. Lurçat wrote: "Cependant, les différentes époques d'architecture nous le montrent, jamais ou presque jamais, il n'a existé d'architecture employant dans un même bâtiment des matériaux différents; il est nécessaire d'avoir un aspect

comment was a criticism of the contrast between the naked brick and the coating used in one of Bruno Taut's building.[213] For Lurçat, homogeneity of appearance was a necessary condition for achieving plastic quality. On this theoretical framework, the coating played a positive role in the expression of plasticity.

In 1929, Lurçat further justified the use of coating in light of the aesthetic status given to the structure of buildings. "The structure of a building, like the skeleton of a man, is not pleasant to see. The structure must be covered with an envelope, with a coating that hides the forms that are not necessarily beautiful, since they have not been conceived for their visual harmony but for their strict utility."[214] In Lurçat's house design, the configuration of the structural frame did not precede the conception. It was rather adapted to fit the general plan. For Lurçat, the use of coating was deemed necessary to hide the forms of the building structure, for these forms derived from the rules of utility, not beauty.

During the first half of the 1920s, the concrete structural elements used in modern houses were often conceived as localized complements to the load-bearing concrete blocks. Some of the houses were marked by the absence of a real dichotomy between the concrete elements (posts, floors) and the concrete masonry walls, cancelling the distinction between structural and infill materials. The porous and heterogeneous quality of the cement or cinder blocks demanded that the masonry be covered by a protective coating that was obviously related to the question of labor and costs. A visible masonry wall would have required more attention and skilled craftsmanship, and could only have been executed for a higher cost. Coating was thus conceived as an economical complement to modern masonry and concrete construction, in the same way that

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d'homogénéité pour obtenir de la grandeur et de la qualité plastique." Cited in Cohen (see note 193), p. 261.

213 Cohen (see note 193), p. 261.

214 André Lurçat, Architecture, Paris, Editions Au Sans Pareil, 1929, p. 110: "La structure d'un bâtiment, tout comme le squelette d'un homme n'est pas agréable à voir. Il faut la recouvrir d'une enveloppe, d'un enduit cachant ses formes qui ne sont pas nécessairement belles, n'étant pas conçues en vue de l'harmonie mais de la stricte utilité."

stoneware tiles had been used as the natural complement of concrete construction during the first decade of the century.

In the early 1920s, both Perret and Le Corbusier used coating material to seal and unify the heterogeneous materials of their masonry constructions. The use of coating came to be naturally associated with the concrete cubic houses exhibited at the various Salons d'Automne. Gradually, Le Corbusier began to explore and exploit the compositional and aesthetic possibilities offered by the play of white walls.[215] Gradually, the use of coating came to be recognized in the theory as a means of stressing the plastic quality of the construction. It is only later -- after 1926 -- that the use of coating in modern masonry construction was joined with the idea of concealment. Though first formulated in technical terms, the critique of coating was soon to betray its aesthetic and ideological foundation. For the use of coating could only be interpreted as an operation of concealment after structural expression had come to be equated with architectural truth.

By the end of the 1920s, many architects associated with the new architecture were obviously aware that the technique of coating employed for their constructions was not without problems. Lurçat himself expressed concern for the development of a revetment that would improve on the technique currently available. "I imagine an ideal revetment of facades: a vitreous material sprayed with compressed air, and allowing rapid and frequent cleaning by means of pumps. Until then I employ the *ciment-pierre*."[216] The motivating idea was to still find a coating that could overcome the technical problems encountered, not to give in to the current discourse on the truth of materials and its corollary association of coating with concealment and lie.

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215 On Le Corbusier's exploration of the contrast between modern (concrete) and traditional (stone) walls covered with white paint or coating, see Bruno Reichlin, "La 'Petite maison' à Corseaux. Une analyse structurale", Le Corbusier à Genève 1922-1932, Lausanne, Payot, 1987, pp. 119-134.

216 Marcel Zahar, "Parlons architecture: André Lurçat nous dit...", La Patrie, April 1928: "J'imagine un revêtement idéal des façades: une matière vitrifiée projetée par l'air comprimé, et permettant des lavages rapides et fréquents à l'aide de pompes. En attendant, j'emploie le ciment-pierre."

Conclusion

As the preceding analysis reveals, the polemical argument developed by Perret tainted most of the interpretations of French modernism of the period.[217] Reiterating Perret's critique of the use of coating in modern architecture -- and the corollary association of this practice with an operation of concealment of the structural frame -- Jirmounsky yielded to the contemporary rhetoric on constructional and material truth. Jirmounsky proposed to frame the distinction between Perret's and Le Corbusier's ideas and works in terms of the opposition between *constructivité* and *plastique*. But *constructivité* and *plastique* were approached in stylistic terms, giving precedence to visual appearance over constructional logic. As such, Jirmounsky framed the current debate on reinforced-concrete construction in terms of the figural, not the generative function of the structural frame. Though concerned by the material basis of architectural change, Jirmounsky's final analysis was essentially formalist in character. It brings to light the fact that by the end of the 1920s, French criticism and historiography had successfully achieved the reduction of Rationalist tenets to a simplified rhetoric of building materials.

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217 By 1930, the notion of concealment was also applied to the reading of metal structures. In a review on a new garage erected in Paris, Pierre Vago -- a former student of Perret -- criticized the use of sheet metal that concealed the lightness of the metallic armature. He wrote: "il y a une chose que nous admettons difficilement: c'est que l'on "cache" la construction, pour donner une fausse impression." Pierre Vago, "Rue Marbeuf", Le maître d'oeuvre, Paris, vol. 5, nos. 41-42, 1930, p. 24.

CHAPTER VII

FRENCH MODERNISM AND THE RELATIVISM OF STRUCTURAL AND REVETMENT MATERIAL (1930-34)

In Modern Architecture: Romanticism and Reintegration, published in 1929, Henry-Russell Hitchcock proposed a historical interpretation of the new European architecture of the 1920s.[1] In his excursus on "the architecture of the future", Hitchcock proved most interested in the symbolic relation between modern materials and modern forms.[2] An attentive observer of the European scene, Hitchcock remarked that the aesthetic expression of modern architecture was at that time closely associated with the smooth surfaces of the buildings in reinforced concrete. While acknowledging the role played by new techniques in the development of modern architecture, he questioned the deterministic relation between modern materials and modern aesthetic.[3] Hitchcock further questioned the claims that linked the future of modern architecture to the exclusive use of reinforced concrete: "There is no assurance in view of the development of engineering that the ferro-concrete construction upon which the present aesthetic of the New Pioneers largely reposes will continue to be technically the most satisfactory."[4] He believed that the aesthetic of the New Pioneers derived from reinforced- concrete construction, but that this aesthetic was often adopted even when other building systems were used, as was the case with some works of Gropius and Mies van der Rohe.

For Hitchcock, the question of materials in modern architecture was ultimately related to the confrontation between industrial and natural materials: to the symbolism of materials. "They [the New Pioneers] have as far as possible excluded the use of

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[1] Henry-Russell Hitchcock, Modern Architecture: Romanticism and Reintegration, New York, Payson & Clarke, 1929.
[2] See the book's last chapter entitled "The Architecture of the Future: 1929" (see note 1), pp. 207-220.
[3] Hitchcock wrote: "It already appears that the more extreme technical point of view often professed by the New Pioneers is primarily a battle cry and a subject for manifestos. It had its use in the establishment of a new aesthetic, but it has probably no continuing validity." Hitchcock (see note 1), p. 210.
[4] Hitchcock (see note 1), p. 210.

traditional materials in order to emphasize the importance of their innovations and because the interpretation of traditional materials was too completely dependent on the aesthetic of the New Tradition".[5] Paraphrasing J.J.P. Oud, Hitchcock believed that certain materials had to be avoided for they were "unsuited to the symbolism of the new manner by their irregularity and natural character." He further added: "In the present period of transition, however, not merely such extreme examples but traditional materials in general imply the past rather than the present and must be avoided for psychological, not technical reasons."[6] As such, Hitchcock hinted at the probable return of traditional, that is to say, of natural materials.

Being chiefly concerned with the forms of the new architecture, Hitchcock focused on the symbolic not the technical aspect of structural and revetment materials. In so doing, he pointed toa key issue of architectural modernism, an issue that was to be at the forefront of architectural debate in France during the early 1930s: the meaning of materials. Evidence of this renewed concern for building materials was the survey published in the pages of the newly founded journal L'Architecture d'Aujourd'hui in 1930.[7] The results of this survey are an index of the conception of structural and revetment materials in French architecture. First, it confirmed the return of metal in French architecture discourse, almost thirty years after its theoretical eclipse at the turn of the century. Second, it confirmed the widespread concern for the technique and aesthetic of revetment materials. This attention to materials merely anticipated the changes that were to affect fundamentally both architectural discourse and practice. These changes were to be highlighted by the confrontation between industrialization and craftsmanship and by the discussion of the beauty of natural materials.

1. On the Return of metal in French Architecture

[5] Hitchcock (see note 1), p. 212.
[6] Hitchcock (see note 1), p. 213.
[7] [Anonymous], "Notre enquête sur les matériaux de la construction", L'Architecture d'Aujourd'hui, vol. 1, no. 1, November 1930, pp. 16-26; vol. 1, no. 2, December 1930, pp. 32-38.

The survey on building materials conducted by L'Architecture d'Aujourd'hui was based on interviews conducted among a number of French and foreign architects. The French architects interviewed were Alfred Agache, Raymond Fischer, Gabriel Guévrékian, Marcel Hennequet, André Lurçat, Robert Mallet-Stevens, Georges-Henri Pingusson, Michel Roux-Spitz, and Marcel Temporal. The first among the few questions asked focused on the choice of structural materials: "Could you indicate your preferences as between building with a structural frame or building in load-bearing brick or cut stone? In the case of a structural frame, do you prefer iron or reinforced concrete? Which infill material do you choose?"[8]

As expected, the majority opted for the use of the structural frame, considered lighter and more economical than traditional load-bearing walls. Positions diverged, however, regarding the choice of structural material: iron or reinforced concrete. In contrast with the then-current historiographic interpretations focusing on the hegemony of reinforced-concrete construction, a majority of architects claimed to favor the use of the metal frame.[9] This preference was shared by Agache, Mallet-Stevens, Hennequet, Guévrékian, Pingusson, and Temporal. For their part, Lurçat, Fischer, and Roux-Spitz sustained that the choice of structural material depended on the nature of the program. However, they shared the same evaluation of the proprieties of each system. The main quality of metal construction was rapidity of execution, and the potential it offered to later modify or enlarge the original building. By contrast, reinforced concrete was valued for

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[8] "Enquête", L'Architecture d'Aujourd'hui (see note 7), p. 16: "Pourriez-vous nous indiquer les cas où vos préférences vont soit au bâtiment avec ossature soit au bâtiment en briques ou pierre de taille portantes ? Dans le cas d'ossature, pourriez vous nous indiquer, pourquoi selon les circonstances vos préférences vont au fer ou au béton armé ? Quel remplissage choississez-vous ? "

[9] Commenting on this investigation, Gilles Ragot correctly notes that the preference for metal was in apparent contradiction with the modernist apology for reinforced concrete. Ragot takes these results as an indication of the discrepancy between architectural practice and discourse during the 1920s. I would argue, rather, that it confirms the return of metal in French construction, and the corollary discrepancy between modernist historiography and practice at the beginning of 1930s. Gilles Ragot, "Le mouvement moderne 1922-1933. Exigences et compromis", doctoral dissertation, Paris IV- Sorbonne, October 1993, p. 159.

its quality as a monolithic material, its resistance over time, its flexibility in the conception of plans, and its malleability for the conception of new forms.

André Lurçat's responses provide an insight into the current understanding of the properties of structural materials. For large-scale buildings, like a factory or a plant, Lurçat called for the use of a metal frame with a simple shape. In the case of a more complex frame, he recommended the use of reinforced concrete. For small buildings, Lurçat distinguished between mass-housing and isolated constructions. Mass housing lent itself to industrialization and the use of metal frames complemented with infill materials. Isolated houses were suited to the use of load-bearing walls made of local materials.[10]

This predilection for the metal frame contrasted with the hegemonic position assigned to reinforced-concrete construction during the 1920s. This shift of interest from reinforced-concrete to metal cannot be assessed without taking into consideration the changes that occurred in the economy of the building industry during the 1920s.[11] But economic factors alone cannot explain the change of architectural conception. The shift of interest from the reinforced-concrete to the metal frame indicated a gradual shift in the conception of the building process itself. With reinforced concrete, the building process derived from the homogeneous paradigm of masonry construction. By contrast, metal frame construction was deeply associated to the idea of *montage à sec*. With the metal frame, the building process was more and more conceived as the dry assembly of industrialized materials or elements. The metal frame -- and the corollary process of *montage à sec* -- fostered a different conception of both the modern wall and its external revetment.

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[10] "Enquête", L'Architecture d'Aujourd'hui (see note 7), November 1930, p. 19: "A. Constructions importantes: Dans le cas d'une usine, d'une ossature de forme très simple, de préférence en charpente métallique. Dans le cas d'une ossature de forme plus complexe: béton armé. B. Petite construction: Pour des maisons en série: ossature métallique et matériaux de remplissage; le tout préparé en usine (économie). Pour une maison isolée et simple: matériaux de pays et murs porteurs."
[11] On this question, see Antoine Picon, Philippe Potié, Frédéric Seitz, "Les entreprises de construction métallique en France", preliminary research report, Paris, June 1993.

The Competition of the *Société des Forges*

The first overt signs of a renewed interest in metal construction appeared in the spring of 1927. It took the form of an architectural competition for the design of metal-frame houses organized by the Société des Forges de Strasbourg. The steel works of Strasbourg were engaged in the manufacturing of metal products. The competition's brief called for the design of small houses based on the use of steel structures and other metal products.[12] The goal of the competition was to seek practical as well as aesthetic architectural solutions based on the use of metal. The brief insisted that the competition's main goal was to "express the material of metal".[13] This formulation was a direct echo of the position advocated in Perret's *architecture du béton armé*. While the expression of the "material of metal" might have been a constraint imposed by the sponsor of the competition, it was most certainly encouraged by the competition's jury, incidentally presided over by Auguste Perret himself. Completed in October 1927, the thirty competition projects were exhibited at the Paris Parc des Expositions in January 1928.[14] Among the three prizes awarded by the jury, the first two were given to the architects André Le Donné and Adrien Brelet, two former students of Perret at the *atelier* of the Palais de Bois. Together with Oscar Nitzchké, Le Donné and Brelet were commissioned to design a model of metal-frame house they chose to revest with corrugated steel sheets (fig.120).

The return of metal to the stage of architectural experimentation and debate was the outcome of a commercial strategy developed by the both the steel industry and builders specializing in metal construction. In 1927, the Chambre syndicale des entrepreneurs de construction métallique en France had distributed to all French architects a document

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[12] Forges de Strasbourg, <u>Concours pour la construction d'Habitations Métalliques</u>, Paris, April 1927 (Fonds Perret, 535 AP 315).
[13] Forges de Strasbourg (see note 11): "Exprimer la matière métallique".
[14] Gabriel Morice, "Concours pour la construction d'habitations métalliques ouvert par la Société des Forges de Strasbourg", <u>L'Architecture</u>, vol. 41, no. 7, 15 July 1928, pp. 207-210.

comparing the respective qualities of metal and reinforced-concrete construction.[15] Interest in metal was further encouraged by the creation of the Office technique pour l'utilisation de l'acier (O.T.U.A.) in 1928. The O.T.U.A. was an independent agency set up by the French steel industry to promote the use of steel in construction and architecture.[16] The campaign of the O.T.U.A. was publicized in Acier, a commercial journal that began to appear in 1929. Though a primary goal of the O.T.U.A. was the promotion of metal construction for tall buildings, it was also encouraging the use of metal in small-house construction.[17] It is in this context that the O.T.U.A. organized an exhibition of metal-frame houses at the Exposition de l'Habitation in Paris in 1929. The exhibition was held at a time of increasing interest in the industrialization of housing.[18] Commenting on the exhibition, an economist critic clearly indicated the motivation behind this exercise. Noting that since the end of the war France could not sell all of its steel production, he stressed that the use of metal had to be approached as an issue of national interest.[19]

The metal-frame house

The 1929 Exposition de l'Habitation provided the occasion for an overview of the design of the metal-frame house in France.[20] In a special issue of Acier, the architect Urbain Cassan identified five types of house based on metal construction.[21] Each house type

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[15] Picon, "La chambre syndicale des entrepreneurs de construction métallique de France", in "Les entreprises de construction métallique en France" (see note 11), pp. 58-71.

[16] The O.T.U.A. was created by the Union des industries métallurgiques et minières.

[17] See especially: "Procédés nord-américains de constructions métalliques d'immeubles", Acier, no. 3, 1929; "Le gratte-ciel Américain", Acier, no. 3, 1931.

[18] See Roger Ginsburger, "A propos de la crise du logement. La construction rationnelle à l'étranger", La Nature, no. 2803, 15 February 1929, pp. 152-158; see also: L'Architecture Vivante, Fall 1929.

[19] P. B., "Les maisons d'acier", Revue Foncière et immobilière, October 1929: "Savez-vous d'abord que depuis la fin de la guerre la France n'écoule plus toute sa production d'acier ? -- on parle de 40% de notre production sans écoulement, -- il semble donc tout d'abord qu'il y ait un intérêt national à défendre."

[20] For a brief overview of the metal-frame house in France, see Joseph Abram, "Perret et l'école du classicisme structurel (1910-1960)", vol. 1, Nancy, S.R.A., 1985, pp. 282-295; also: Ragot (see note 9), pp. 163-190.

[21] Urbain Cassan, "Les maisons métalliques françaises", Acier, no. 2, August 1929.

was clearly linked to a firm, that specialized either in steel production [Ironworks] or in the industrial manufacturing of houses. The reviewer made a distinction between houses with a metal frame and those with a structural wall.[22] Metal could be used for either or both the frame and the revetment.

It is in the context of the exhibition that Urbain Cassan presented a model designed for the Forges et Ateliers de Commentry-Oissel (fig.121). Conceived on the basis of the newly adopted the Loucheur law, the model proposed involved a metal frame with a masonry infill made of new light industrial materials (like *aérocrète* and cellular concrete).[23] The architectural character of these metal house models was mostly determined by the conception of, and relation between, structure and revetment. According to Joseph Abram, the house type proposed by the Ateliers de Commentry-Oissel enabled a certain degree of differentiation, because it could accept different kinds of coating and external revetment.[24] It was more difficult to achieve such differentiation with the house type based on the use of steel panels for the external revetment, like the one proposed by the Forges de Strasbourg. This last model, a type based on a metal skeleton and a light composite wall clad with steel sheets, was especially conceived to express through its architecture the use of metal as both a structural and revetment material.

The current conception of the metal house was often approached in terms of the idea of *montage à sec*. The idea of *montage à sec* implied a type of construction and a building process that would do away with the use water on the building site, that limited the use of building materials that had a fluid quality, like concrete and plaster. It also implied the dry assembly of building parts without the need of liquid binders such as cement or mortar. Finally, *montage à sec* implied the extensive use of the range of new

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[22] Cassan (see note 21): "la maison de la Société de construction métalliques Fillod, Comefi, de type mur composé sans ossature."
[23] The model was illustrated in Pierre Souchon, "L'épiderme de la maison", Le Bâtiment illustré, no. 2, February 1931, p. 23.
[24] Abram (see note 20), p. 289.

industrial materials employed to constitute the infill, the insulation, and the revetment of the light, multi-layered modern walls.

Not all the models presented at the 1929 Exposition de l'Habitation derived from the recent promotional activities of the French steel industry. One of them, the maison Isotherme Decourt, had been conceived in 1923 and first presented to the public at the 1925 Exhibition of Decorative Arts in Paris. Based on a steel frame with an external wall made of sprayed cement, the Decourt system sought to combine the advantages of metal with reinforced-concrete construction. The system was described and advertised in the pages of Le Corbusier's Almanach d'Architecture Moderne published in 1926.[25] Between 1925 and 1930, the system was used for the construction of various buildings. Most noted was its use in the construction of a villa at Saint-Cloud (1926-27) designed by the architect Jean-Charles Moreux (fig.122).[26] For the construction of the villa, the architect worked in close association with Raoul Decourt, the developer of the system . A key characteristic of the system was that the entire structure based on a light metal frame [*fers profilés*] was given a uniform envelope made of cement sprayed on a wire mesh, a technique involving the cement-gun. Le Corbusier had used the cement-gun for the construction of the houses at Lège (1923-25), Pessac (1924-27), and the Esprit Nouveau pavilion of 1925.[27] But while Le Corbusier's experience with the cement-gun in Bordeaux proved less than successful, Moreux made proficient use of the system.[28] So convincing was his experience that Moreux planned to use a similar system for the construction of low-cost housing in the new developments of the former fortifications around Paris (fig.123).[29] In the 1925 description of the system, the cement was sprayed

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[25] Le Corbusier, Almanach d'Architecture Moderne, Paris, Crès, 1926, p. 192.
[26] Charles-Edmond Sée, "Une villa moderne à Saint-Cloud. Par M. Moreux, architecte D.P.L.G.", La Construction Moderne, vol. 43, no. 38, 17 June 1928, pp. 445-450; Marcel Zahar, "L'architecture contemporaine. Jean-Charles Moreux", L'Art Vivant, no. 99, 1 February 1929, p. 131.
[27] See chapter V.
[28] On Le Corbusier's lack of success with the cement-gun, see B.B. Taylor, Le Corbusier at Pessac 1914-1928, exh. cat., Harvard Univ.-Fondation Le Corbusier, 1972, p. 14.
[29] Ragot (see note 9), p. 168.

from the outside in without the use of formwork.[30] It is this method that was used by Moreux for the villa at Saint-Cloud.[31] In the 1930 commercial catalogue, Decourt proposed two methods: without formwork, with the cement sprayed outside in; with formwork, with the cement sprayed from the inside out, enabling the making of a flat and regular surface.[32] According to Cassan, it is this second method (with formwork) that was used for the construction of the Decourt house model exhibited at the Exposition de l'Habitation.[33]

The Maison Isotherme developed by Decourt was placed in the category of metal construction. Yet the external appearance of the Decourt house -- like the model of the Forges et Ateliers de Commentry-Oissel -- recalled the aesthetic of reinforced-concrete construction. For the architectural commission of the O.T.U.A., the Decourt building system did not set any limitations on the appearance of the works executed. Houses built with the system could resemble any type of construction based on the use of coating for the external skin.[34] For the O.T.U.A., the key issue was the spread of metal construction. For architects, however, the use of metal could not but trigger the issue of the formal qualifications of the metal house. Most reviewers praised the projects exhibited at the 1929 Housing exhibition. But some -- like the reviewer of Le Maître d'Oeuvre -- were more critical, stressing that many of the houses were merely "metal disguised as masonry".[35] Founded by former students of the Ecole Spéciale d'Architecture, Le Maître

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30 René Doncières, "Une révolution dans l'art de construire les maisons", La Science et la Vie, vol. 27, no. 99, September 1925, pp. 228-230.
31 Sée (see note 26), p. 449.
32 [R. Decourt], La Maison Isotherme. Procédés R. Decourt, catalogue, Nancy-Paris-Strasbourg, 1930, p. 29.
33 Cassan (see note 21).
34 La Maison Isotherme (see note 32), p. 30: "il [Decourt system] n'apporte donc pas de limites étroites à l'aspect des ouvrages réalisés, si ce n'est celui d'un épiderme extérieur semblable à une construction quelconque revêtue d'un enduit."
35 The reviewer of Le Maitre d'Oeuvre wrote: "Les autres spécimens de maisons métalliques, n'étaient malgré la qualité de leur exécution, que du 'métal déguisé en maçonnerie'". Cited in [Anonymous], "L'Acier dans la Construction des Immeubles", La Revue de l'Habitation, vol. 26, no. 107, January 1930, p. 5.

d'Oeuvre was strongly indebted to the position defended by Perret.[36] By 1930, Perret's conception of material truth had been extended to the domain of metal construction.[37] Beyond questions of cost or comfort, the "visibility" of building materials remained a key issue of the architectural debate.

Henri Sauvage and metal construction

The adoption of the Loucheur law in July 1928 was probably the single most influential factor in the development of the metal house.[38] Yet some architects were already involved in experimentation with metal construction even prior to the passing of the law. The work of the architect Henri Sauvage is a case in point. Between 1925 and 1931, Sauvage filed many patents for various housing models and construction techniques.[39] During those years, he manifested a renewed interest in the industrialization of construction, an interest confirmed with the foundation of the Société de Constructions Rapides in December 1925.[40] Sauvage's early career was associated with reinforced-concrete construction, yet around 1925, he showed a growing interest in metal construction. His first experience was in the industrialization of building cells.[41] A second step involved him in the industrialization of elements and parts. Sauvage advocated the prefabrication of separate tectonic elements in metal such as external walls and internal partitions. The prefabricated parts were thus limited to planar or beam elements, facilitating transportation to the

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[36] In 1929, Auguste Perret accepted the offer of Henri Prost -- the new director of the Ecole Spéciale d'Architecture -- to supervise one of the school's *atelier*.

[37] In a review of a new garage erected in Paris, Pierre Vago criticized the use of sheet metal that concealed the lightness of the metal armature. He wrote: "il y a une chose que nous admettons difficilement: c'est que l'on "cache" la construction, pour donner une fausse impression." Pierre Vago, "Rue Marbeuf", Le Maître d'Oeuvre, vol. 5, nos. 41-42, 1930, p. 24.

[38] The key characteristic of the Loucheur law was the provision of funds for housing construction combined with a financial arrangement that encouraged the ownership of new houses. Le Corbusier's maison Loucheur of 1928 epitomizes the relation between the Loucheur law and metal construction. For a brief survey of Le Cobusier's experience with metal construction in the late 1920s, see chapter VI.

[39] On Sauvage's experience with prefabrication, see Jean Baptiste Minnaert, "Henri Sauvage, architecte (1873-1932)", doctoral dissertation, Paris IV - Sorbonne, November 1993, vol. 1, pp. 331 ff.

[40] See [Anonymous], "Une formule intéressante de construction rapide - L'architecte Henri Sauvage et la fabrication des maisons en usine ou à l'atelier", Art et Bâtiment, April 1928, pp. 147-153.

[41] Patent of July 1925: "système de construction par cellules indépendantes de maisons d'habitation ou autres". Minnaert (see note 39), p. 342.

building site. This system was applied for the first time in the construction of the house of M. Bruneau-Varilla at Orsay in 1927 [42] By 1928, Sauvage's experiences with steel construction were already noted in a monograph dedicated to his work.[43] In light of these experiences, Sauvage did not hesitate to inform an interviewer in 1929 that "the age of concrete was to end, giving way to the age of steel".[44]

Sauvage did not limit the use of the steel frame to small construction. In 1928, he adopted the metal frame for the extension of the Samaritaine department stone. Executed by the firm Schwartz-Haumont, the structural frame was covered by a stone cladding on the facade. But Sauvage's most compelling experience with steel construction was to be the conception of the Magasins Decré in Nantes in 1930 (fig.124). The origin of the project appears to have been linked with the promotional activities of the O.T.U.A.[45] Also executed by the firm Schwartz-Haumont, the building was entirely conceived in terms of metal construction. In his review of the building, the architect Jacques Tournant stressed the distinction between its structural framework and its ironwork [*serrurerie*], stressing the need for the careful connection of the two types of metal work. The technique used for the Grands Magasins Decré was presented as a construction method analogous to that used by the Americans. Noted for the great speed of its construction, the building was also praised for the overt display of its metal materials.

Architectural circles and metal construction

By 1929, the contemporary interest in metal construction encouraged some architects to question the theoretical hegemony of reinforced-concrete construction; Gabriel

[42] For a description of the house, see "Une formule intéressante de construction rapide" (see note 40).
[43] Gabriel Mourey, Henri Sauvage (Coll. des Albums d'Art Druet, vol. 19), Paris, Librairie de France, 1928.
[44] Maurice Coquelin, "L'architecture moderne à la recherche d'un style d'époque", Revue foncière et immobilière, July 1929 (Fonds Perret, 535 AP 332): "Notons enfin qu'un certain nombre d'architectes, parmi lesquels M. Henri Sauvage, considèrent que l'âge du béton va prendre fin et céder la place à l'acier."
[45] Jacques Tournant, "Grands Magasins Decré à Nantes", L'Architecture d'Aujoud'hui, no. 8, November 1931, pp. 37-45.

Guévrékian, architect of the Villa en ciment armé exhibited at the 1923 Salon d'Automne, was among them. According to Marcel Zahar, Guévrékian was concerned by the too vast possibilities allowed by the use of reinforced concrete, which made possible all kind of architectural excess [46] -- a position that unexpectedly echoed Perret's critique in 1928 of the *esthètes sans métier*, and his warning against the architectural whims concrete permitted.[47] For Guévrékian, the days of reinforced concrete were numbered: "Concrete will soon be set aside; its use is irrational for it requires the support of another material: the formwork. Assembling and disassembling the forms involves too much labor. It is necessary to limit the use of concrete to the elements of the skeleton."[48] According to Zahar, Guévrékian was convinced that the future rested in steel construction and the corollary practice of *montage à sec*. In fact, Zahar himself was not unaware of recent trends in constructional practices in France. In two articles of 1928, Zahar had already noted the current interest in *montage à sec* in the experimental work of Le Corbusier and Henri Sauvage.[49] Guévrékian's disenchanted comment on the illogical nature of reinforced-concrete construction was merely a reflection of the current interest in the new construction practices triggered by the use of metal.

The renewed interest in metal construction was duly recognized by the architectural profession. In December 1929, L'Architecture -- the journal of the Société Centrale des Architectes -- published a technical supplement exclusively devoted to metal construction, which from the outset was presented as a practice rooted in the French tradition, and not a foreign influence or import.[50] "The use of a metal frame for commercial and residential

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46 M. Zahar, "L'Architecture Vivante. Gabriel Guévrékian", L'Art Vivant, no. 97, 1 January 1929, p. 10.
47 See chapter VI.
48 Zahar (see note 46), p. 10: "Le béton sera bientôt écarté; son usage est irrationnel, car il exige le secours d'une autre matière: celle du coffrage. Le travail de coffrer et de décoffrer conduit à d'excessives dépenses de main-d'oeuvre. Il conviendrait de limiter l'usage du béton aux éléments essentiels de la carcasse."
49 Marcel Zahar, "Les principes et les projets de M. Le Corbusier", L'Art Vivant, no. 87, 1 August 1928, pp. 588-590; "Henri Sauvage", L'Art Vivant, no. 88, 15 August 1928, pp. 628-631.
50 [Anonymous], "La Construction Métallique", L'Architecture, Supplément technique no. 7, December 1929.

buildings is not, as some wrongly believe, a new practice of foreign origin. It derives directly from the industrial metal framework [*charpente*], which has been known and employed for a long time in France."[51] Recalling the major achievements of nineteenth-century metal architecture in France, the reviewer insists on the continuity between nineteenth-century iron trusses and twentieth-century steel skeletons. For the reviewer, the reasons for the lack of penetration of steel in the construction industry had mostly to do with the problem of availability: "If the metal frame has not been widely used in France during the last few years, it is mostly because of the difficulty encountered, during and after the war, in obtaining the needed supplies of *profilés* and *tôles*, steel-industry production having been totally absorbed during the war by the needs of National defense, and all the stocks having been destroyed."[52] But for L'Architecture a new wave of interest in metal construction was clearly perceptible among French architects.[53]

This renewed interest in metal construction gave rise to an unexpected debate among engineers and construction specialists, encouraging the critical comparison between reinforced-concrete and metal construction. In the Supplement of L'Architecture, the properties of metal construction were naturally measured against those of concrete. In Constructions moderne published in 1929, the engineer Charles de Mocomble went further, and questioned the current apology for reinforced-concrete construction.[54] After a careful analysis of the history and current developments of the two main structural materials made available by modern industry, de Mocomble compared the respective

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[51] "La Construction Métallique" (see note 50), p. 3: "L'emploi d'une ossature métallique pour le bâtiment commercial ou d'habitation, n'est pas, comme certains le pensent à tort, une nouveauté d'origine étrangère. Elle dérive directement de la charpente métallique industrielle, connue et employée en France depuis longtemps."

[52] "La Construction Métallique" (see note 50), p. 3: "Si l'ossature métallique ne s'est pas répandue plus rapidement en France, dans ces dernières années, c'est à cause surtout des difficultés recontrées pendant et après la guerre pour obtenir les approvisionnements nécessaires en profilés ou en tôles; la production des aciéries ayant été totalement absorbée pendant la guerre par les besoins de la défense nationale et tous les stocks ayant été réduits à néant."

[53] "La Construction Métallique" (see note 50), p. 3: "une tendance marquée en faveur de la construction par l'emploi de l'acier se dessine à nouveau chez nous, accusant ainsi la faveur croissante dont ce mode de construction jouit auprès des architectes."

[54] Charles de Mocomble, Constructions Modernes, Paris, Librairie J.-B. Baillière et Fils, 1929.

properties of the two systems.[55] For de Mocomble, the reputation of reinforced concrete was over-rated: "....instead of pretending, like some do a little too audaciously, that reinforced concrete is now the only building material that possesses all the needed qualities, and that metal construction must give in and disappear, it would be wiser to believe that the two materials can complement and support each other."[56] For de Mocomble, it was essential to evaluate all aspects of the construction process in order to make the appropriate choice of structural material.

The critique of the advocacy of reinforced concrete was quickly introduced into architectural discourses. In the first issue of L'Architecture d'Aujourd'hui, largely devoted to the question of building materials, the competition between metal and reinforced concrete found an appropriate context. In an article devoted to steel as a construction material, J. Cléret de Langavant contested the dominant position of reinforced concrete,[57] writing that concrete "must not be considered, properly speaking, as a special material, but rather as representing a new technique in the use of steel. The invention of cement did not revolutionize the building industry; by contrast, the invention of steel has completely changed the techniques and transformed the art of the builder."[58] Framing reinforced-concrete construction in terms of the essential role played by the metal armature, de Langavant proposed an interpretation that -- surprisingly -- recalled the architectural interpretation of the new heterogeneous material that was common at the turn of the century. Though de Langavant's interpretation did not produce much of an echo, it

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55 "Résumé comparatif de la construction métallique et de la construction en béton armé", in de Mocomble (see note 54), pp. 209-238.

56 De Mocomble (see note 54), p. 237: "...mais au lieu de prétendre, un peu trop audacieusement comme certains, que le béton armé est désormais le seul matériau doué de toutes les qualités et que la construction métallique doit s'incliner et disparaître devant lui, sans doute serait-il plus sage de penser que les deux matériaux peuvent se compléter et se prêter un mutuel appui."

57 J. Cléret de Langavant, "L'acier: matériau de construction", L'Architecture d'Aujourd'hui, vol. 1, no. 1, November 1930, pp. 47-51

58 Langavant (see note 57), p. 47: "Ce dernier toutefois ne doit pas être considéré comme étant, à proprement parler, un matériau spécial, mais bien plutôt comme représentant une technique nouvelle de l'emploi de l'acier. L'invention du ciment n'a pas révolutionné l'industrie du bâtiment, l'invention de l'acier, au contraire, a complètement bouleversé les techniques et transformé l'art du constructeur".

nonetheless reflected the growing discontent with the excessive hegemony of reinforced concrete in architectural discourses.

The Maison de verre (1930-32)

The most compelling exemplar of the return of metal on the French architectural scene was the construction of the Maison de verre (1927-31) in Paris, by Pierre Chareau and Bernard Bijvoet.[59] But the combination of glass and steel of the Maison de verre was not really indebted to the changes of the late 1920s in the conception of constructional process and materials. The design of the house was the result of a long process. The use of a steel frame was not prescribed from the start. In fact, the first two requests for building permits, filed 23 November 1927 and 11 August 1928, were for a reinforced-concrete skeleton.[60] The posts were placed in front of the lateral walls which were excluded from the structural system. But in the executed project metal was substituted for reinforced concrete, and the lateral walls regained their load-bearing function. The construction of the building, apparently started in June 1928 (ahead of the building permit of 21 August 1928) and was completed in December 1931. The metal armature was adopted in the summer of 1928. The posts and beams of the Maison de verre were "reconstituted" -- that is to say, fabricated of simple metal sections [*profilés*] hammered on the site by metal workers.[61] During the cooling process, the rivets would retract, realizing the perfect mechanical assemblage of the two sections. Crafted of assembled metal elements, both riveted and bolted, and covered with tile slates on its flat sides, the skeleton of the Maison de verre was rooted in nineteenth-century technical culture.

As a custom-made project, the Maison de verre did not share in the current interest in the industrialization of housing. In that respect, and despite some apparent similarities

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59 In the words of Marc Bédarida, "la Maison de verre consacre l'emploi de l'acier et du verre à la place du béton, matériau canonique de l'entre-deux-guerre." Marc Bédarida, "Maison de verre ascendances et filiations", Pierre Chareau architecte, un art intérieur, Paris, Editions du Centre Pompidou, 1993, p. 112.

60 Olivier Cinqualbre, "Maison de verre", Pierre Chareau architecte (see note 59), pp. 70-75.

61 Bernard Bauchet, "Archéologie de la maison de verre", Pierre Chareau architecte (see note 59), p. 10.

(such as the use of Nevada glass bricks), the Maison de verre is very different from the Immeuble Clarté (1930-32) designed by Le Corbusier and Pierre Jeanneret in collaboration with the industrialist Edmond Wanner.[62] The skeleton of the Immeuble Clarté was fashioned with a different kind of metal beam and assembled with the new technique of electric arc welding.[63] At the constructional level, the carefully crafted frame of the Maison de verre contrasted with the industrially produced frame of the Immeuble Clarté. At the aesthetic level, the thick, riveted and bolted surfaces of the Maison de verre skeleton contrasted with the thin, smooth, uninterrupted surfaces of the Immeuble Clarté skeleton. It was essentially the contrast between nineteenth-century building culture and twentieth-century industrial aesthetic.

Conclusion

By 1930, metal had achieved a major come-back in French architectural discourse and practice. The return of metal as a structural material did much to alter the discourse on materials sustained by the protagonists of the French modern movement, as the technical determinism that had marked the discourse of modernist architects gave way to a more relativistic position. Its more immediate impact was to downplay the modernist equation between materials and forms.

The return of metal also influenced the conception of modern construction. Encouraged by the Loucheur law, the return of metal construction was often conceived in terms of the practice of industrialization. By 1930, metal had come to replace reinforced-concrete as the privileged material for achieving the goal of industrialized construction. A testimony to the inherent limits the industrialization of reinforced-concrete construction, this interest in metal clearly marked a shift from the building site to the workshop and factory. Moreover, metal construction was broadly understood as a technique that

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62 For a comparison of the two buildings, see Christian Sumi, "L'immeuble clarté et la conception de la 'maison à sec'", in Le Corbusier à Genève 1922-1932, Lausanne, Payot, 1987, pp. 107-109.

63 The new technique of arc welding was described in the O.T.U.A. journal Acier, no. 3, 1930.

permitted *montage à sec*, encouraging a new conception of the wall as a membrane constituted with new types of industrialized materials.

With the return of metal construction, architects were compelled to make the choice of structural material according to the program and the condition of production. Many architects were to assign to each system a specific building type. In his analysis of the minimal house presented at the second CIAM congress, Le Corbusier could write that he favored the use of reinforced-concrete for large building sites and iron for dry-assembled small houses.[64] This theoretical distinction was relative, however, determined as much by national circumstances (the minimal house and the loi Loucheur) as by fundamental structural properties.

2. On the Question of External Revetments

The return of metal in French architectural discourse was to challenge the dominant interpretation on the privileged material of modernism. It was to be paralleled by an equivalent relativism regarding the issue of external revetments. The survey on building materials conducted in 1930 by L'Architecture d'Aujourd'hui revealed this change of attitude. The question asked was: "Which revetment or external coating do you prefer? Do you think it is preferable to leave the material naked and visible, and to choose it accordingly, or do you prefer to unify the external aspect of the facade by means of a coating or a revetment?"[65] From the outset, the issue of external revetment was framed in terms of the visibility of building materials understood as an aesthetic choice ("to unify the external aspect of the facade") in a phrasing directly borrowed from the doctrinal

[64] Le Corbusier wrote: "le fer et le béton armé se prêtent à ces nécessités [plan et facades libres], le béton pour de grands chantiers et le fer pour des maisons disséminées et montées à sec". Le Corbusier, Pierre Jeanneret, "Analyse des éléments fondamentaux du problème de la "maison minimum", La Revue de l'Habitation, vol. 26, no. 107, January 1930, p. 6.

[65] "Enquête", L'Architecture d'Aujourd'hui (see note 7), no. 1, p. 16: "Quel revêtement ou enduit extérieur [préférez-vous] ? Croyez-vous bon de laisser le matériau nu et apparent et de le choisir en conséquence, ou préférez-vous unifier l'aspect de la façade par un enduit ou revêtement ?"

position developed and defended by the Perret circle. By 1930, this doctrine had evidently become a central point of reference in the discussion of the conception of building materials.

During the 1920s, a number of architects had adopted the use of coating to produce an architecture of monochromatic, uniform, and abstract surfaces. Responses to the 1930 survey are indicative of a change of attitude. Most architects were then inclined to use various types of revetments. Except for Agache, Lurçat, and Mallet-Stevens, those interviewed were critical of the use of coating. According to Raymond Fischer, painted cement coating could hold up for some years, but most types of coating were not sufficiently resistant. Because of these current technical limitations, he encouraged architects to temporarily abandon coating. In defense of his argument, Fischer gave Perret's practice as an example: "The master Auguste Perret has reinstated the antique method of visible materials. The posts, lintels, and floors are in reinforced-concrete, rough cast. Between the wall openings, the brick infill is left visible."[66] Georges-Henri Pingusson was also critical of the use of coating, which he believed should not be used in the city because it did not weather well. Like Fischer, he preferred to leave the material visible. To do so, Pingusson favored the use of a concrete carefully made with special fine gravel [aggregate] and in a special casting process. The concrete could then be colored in the mass and its surface bush-hammered.[67]

A majority of architects among them Hennequet, Guévrékian, and Roux-Spitz, favored the use of mineral revetments: a cladding of hard stone, polished marble, or other mineral revetment materials. Hennequet argued that it was preferable to leave the "material" naked. But since it was difficult to get an acceptable appearance with rough concrete, the only solution left was the adoption of mineral revetments.[68] Guévrékian

[66] "Enquête", L'Architecture d'Aujourd'hui (see note 7), no. 1, p. 21: "Le maître Auguste Perret a remis à la mode l'antique méthode des matériaux apparents. Les poteaux, les linteaux et les planchers, sont en béton-armé, bruts de décoffrage et entre les surfaces éclairantes, la brique de remplissage est apparente."
[67] "Enquête", L'Architecture d'Aujourd'hui (see note 7), no. 2, p. 34.
[68] Hennequet said: "Comme revêtement ou enduit extérieur: le plaquage en pierre dure, le granito de marbre poli en prenant certaines précautions. Il serait préférable de laisser le 'matériau' nu et apparent,

also opted for external revetments of a mineral nature, like stone slabs or polished marble. His choice, however, was motivated by its capacity to unify the appearance of the facade.[69] For his part, Roux-Spitz advocated the covering of the building skeleton with a skin made of a cladding of hard stone slabs.

Roux-Spitz's preferences are indicative of evolving positions within French architectural culture. During the early 1920s, Roux-Spitz shared the doctrinal position defended by Perret, but by the end of the decade had developed an architectural language that was clearly distinct from that of Perret. On the question of structural materials, Roux-Spitz declared that he generally preferred to use reinforced-concrete rather than metal construction. He claimed that reinforced concrete was better suited to his architectural conceptions since it associated more naturally with infill materials. Regarding the question of external revetments, however, Roux-Spitz was highly critical of Perret's advocacy of truth to materials. According to Roux-Spitz, to leave the skeleton visible was maybe appropriate for a certain type of architecture, like a church, but it was not appropriate for a residential building. He claimed the need to give the house an *épiderme*, a skin. For this modern skin, Roux-Spitz favored the use of a cladding of hard stone slabs.[70]

To be sure, Guévrékian and Roux-Spitz did not share the same conception of modernism in architecture. But the discussion of revetment allowed the bringing closer of two competing aesthetic approaches. Mallet-Stevens, Lurçat, and Guévrékian insisted on the importance of unifying the external aspect of the construction. Both Mallet-Stevens and Lurçat reiterated their advocacy of coating. Guévrékian, like Lurçat and Mallet-

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mais cela est bien difficile avec le béton armé brut de décoffrage." "Enquête", L'Architecture d'Aujourd'hui (see note 7), no. 2, p. 23.

69 "Enquête", L'Architecture d'Aujourd'hui (see note 7), no. 2, p. 32.

70 André Bloc, "Opinions de M. Roux-Spitz", L'Architecture d'Aujourd'hui, vol. 1, no. 2, December 1930, p. 9: "Le rationaliste s'appliquera à laisser l'ossature apparente -- mais si cette solution est de grande architecture dans une église elle n'est que cuistrerie dans un immeuble ou une villa où l'ossature n'est qu'un moyen asservi au programme. Il faut donc créer un épiderme à la maison... chaque fois que ça lui est possible, M. Roux-Spitz, à défaut d'autre matériau inexistant à ce jour, plaque ses façades en pierre dure Hauteville ou Rocheret."

Stevens, believed in the necessity to unify the external aspect of the facade.[71] For Mallet-Stevens, the search for external unity was based on the belief that volumes were more important than constructional details.[72] The main difference between these architects lay in the type of external revetment advocated. While Lurçat and Mallet-Stevens still accepted the use of coating, Guévrékian was more skeptical about its durability.[73] For Roux-Spitz, on the other hand, the advocacy of external revetments was openly argued as a critique of Perret's "Rationalist" position.

During those years, Roux-Spitz had built many projects involving the practice of cladding with high-quality stone. In a 1930 review of Roux-Spitz's most recent construction in Paris, Pierre Vago -- an advocate of Perret's position -- wrote about the facade: "the construction is only lightly stressed; the stone cladding that covers the facade is dressed so as to indicate that it has a protective not a constructional function. M. Roux-Spitz is against the expression of the visible skeleton."[74] By 1931, Roux-Spitz's architecture had even become a model praised by L'Architecture d'Aujourd'hui.[75] Shifting attention from the structure to the envelope of the building, Roux-Spitz offered a positive alternative to the dogmatic position advocated by Perret.

Le Corbusier

Le Corbusier's approach to buildings materials was not recounted in the survey of L'Architecture d'Aujourd'hui, but his architectural practice of the early 1930s reveals of

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71 "Enquête", L'Architecture d'Aujourd'hui (see note 7), no. 2, p. 32: "Je crois bon d'unifier intégralement l'aspect de la facade."

72 "Enquête", L'Architecture d'Aujourd'hui (see note 7), no. 1, p. 18: "Je préfère unifier l'aspect de la façade, estimant que les volumes comptent plus que les détails constructifs."

73 As the external envelope of the villa Cavroix at Croix near Roubaix (1931-32) shows, Mallet-Stevens was also open to the use of colored bricks. See Pierre Joly, "La villa à Croix", Rob Mallet-Stevens. Architecture, mobilier, décoration, Paris, AAVP- Philippe Sers, 1986, p. 52.

74 Pierre Vago, "Un immeuble nouveau", Le Maître d'Oeuvre, vol. 5, no. 48, 1930: "la construction y est accusée avec une extrême légèreté; le placage en pierre qui couvre les façades est appareillé de façon à indiquer clairement sa fonction protectrice et non constructive. M. Roux-Spitz est contraire à une ossature apparente et visible, qu'il considère "une recherche absolument stérile et pédantesque"

75 See Pierre Vago, "Quelques immeubles nouveaux", L'Architecture d'Aujourd'hui, vol. 2, no. 5, July 1931, pp. 12-20.

new interest for revetment materials. While the villas of the 1920s were characterized by the uniformity of their external walls, all treated with a homogeneous cement coating -- up to the villa Savoye, designed in 1928 and completed in 1929 -- the domestic projects of the early 1930s came to be identified by their use of natural materials. Beginning with the studies for the maisons Loucheur of 1928, Le Corbusier effectively reintroduced natural materials in the conception of several projects. Pursued with the villa de Mandrot (1929-31) at Le Pradet, near Toulon, and the maison Errazuriz (1930) in Chile, the use of natural materials was also to be noted as one of the key features of the Swiss Pavilion (1930-33) in Paris. Because of the curved shape and rough-stone masonry wall of the ancillary block, together with the rough-cast concrete pilotis, the Swiss Pavilion is conventionally presented as a threshold moment in Le Corbusier's shift from Purism to Organicism.[76]

The source of this new interest is still a matter of debate. According to Tim Benton, Le Corbusier's reassessment of materials was already reflected in his paintings of 1926-28.[77] Yet, discussing the maisons Loucheur project of 1928, Benton also points to a clause of the Loucheur law that encouraged the use of local materials and techniques.[78] According to Kenneth Frampton, "after 1930, Le Corbusier no longer believed in the Purist project as the manifest destiny of the machine-age civilization", a disbelief that coincided with the primitive building techniques and rustic materials that began "to appear as consciously expressed in Le Corbusier's work from 1929 onwards".[79] The interest in natural materials was acknowledged by Le Corbusier himself. Describing the Errazuriz house built in Chile in 1930, Le Corbusier wrote in the second volume of the Oeuvre

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[76] See William J. R. Curtis, "Ideas of Structure and the Structure of Ideas: Le Corbusier's Pavillon Suisse", JSAH, vol. 40, December 1981, pp. 295-310.
[77] Tim Benton, "Six houses", in Le Corbusier, Architect of the Century, London, Arts Council of Great Britain, 1987, p. 65.
[78] Benton (see note 77), p. 65.
[79] Kenneth Frampton, "The other Le Corbusier: primitive form and the linear city 1929-52", in Le Corbusier Architect of the Century (see note 77), p. 30.

complète: "The rustic quality of the materials does not prevent the definition of a clear plan and of a modern aesthetic."[80]

Because of his interest in the expressivity of natural materials, Le Corbusier's new approach to materials appears to have been more radical than that advocated by other modern architects like Lurçat or Mallet-Stevens. In effect, Le Corbusier's approach to materials in the early 1930s is most often presented as a rupture and a turning away from his practice of the 1920s. Mary McLeod's interpretation is a case in point. Focusing on the political dimension of Le Corbusier's architectural practice, McLeod points to the architect's interest and involvement in the Regional syndicalist movement:

> This movement, emphasizing regional groupings and natural hierarchies based upon climate, topography, and race, encouraged a more limited endorsement of technology. Instead of standardization and uniformity, these latter-day syndicalists stressed regional diversity and local traditions. Likewise, Le Corbusier in his own designs, particularly for the small houses Errazuriz, Mandrot, and Mathes, began to employ local building materials and techniques. Just as the rational, geometric forms of the twenties were a manifestation of his faith in technology and American systems of Scientific Management, the rustic, more primitive works of the thirties were a rejection of the supremacy of this selfsame viewpoint.[81]

Emphasizing the rupture with Le Corbusier's works and beliefs of the 1920s, McLeod tends to downplay the architect's continuing involvement in the development of the materials and techniques of modern construction. Le Corbusier's interest in local materials and techniques does indeed indicate a shift in his conception of materials and technology. However, as I will argue in the following section, this shift must be understood not so much as a rejection but as a reassessment of the architect's conception of building materials in terms of a confrontation and contrast between traditional and industrial techniques and between natural and artificial materials.

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[80] Willy Boesiger, ed., Le Corbusier et Pierre Jeanneret, Oeuvre complète 1929-1934, Zurich, Editions H. Girsberger, 1935, p. 48: "La rusticité des matériaux n'est aucunement une entrave à la manifestation d'un plan clair et d'une esthétique moderne."

[81] Mary McLeod, "'Architecture or Revolution': Taylorism, Technocracy, and Social Change", Art Journal, vol. 43, no. 2, Summer 1983, p. 143.

Modern walls and modern revetments

Le Corbusier's new approach to materials must first be examined in light of his larger-scale projects designed at the end of the 1920s: the Palais de la Société des Nations in Geneva (1926-27) and the Palais du Centrosoyus in Moscow (1928-29).[82] In his competition project for the Palace of the League of Nations, Le Corbusier conceived a reinforced-concrete structure that enabled the construction of a multi-layered masonry wall that combined bricks, hollow bricks, concrete, and polished granite as external revetment.[83] The stripes of stone veneer shown on the perspective drawings, with their alternating pattern of large and narrow slabs, emphasized the non load-bearing function of the wall revetment.[84] The stone veneered wall stripes were interrupted by the *pan de verre*, large glass panes that ran horizontally along the building. Describing the project in Une maison - Un palais, Le Corbusier wrote in 1928: "I decided that these vast buildings would be of a light-grey polished granite; shining; smooth; glossy; that their enveloping forms would be of pure geometry."[85] Treating the polished stone veneer and the continuous glazing as if they were the same material, Le Corbusier still conceived the treatment of surface materials in light of the aesthetic of Purism.[86]

Le Corbusier pursued his experimentation with revetment materials in the project for the Palais du Centrosoyus in Moscow. The design process of the Centrosoyus unfolded in four phases, with the first project conceived in spring 1928 and the final project presented in January 1929.[87] Describing the general aesthetic of the final project

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82 For an analysis of the sequences of these projects, see Kenneth Frampton, "Le Corbusier's Designs for the League of Nations, the Centrosoyus, and the Palace of the Soviets, 1926-1931", The Le Corbusier Archives, vol. 3, New York-Paris, Garland Publishing and Fondation Le Corbusier, 1982, pp. ix-xxii.

83 Le Corbusier, Une Maison - Un Palais, Paris, Crès, 1928, p. 102.

84 Beginning with the Champs-Elysées theater, Perret had insisted on the need to devise revetmrnt patterns that highlighted the non load-bearing function of the stone veneer.

85 Boesiger (see note 80), p. 158: "Décider que ces vastes édifices seraient d'un granit poli gris clair; luisant; lisse; brillant; que leur forme enveloppante serait de pure géométrie."

86 According to Frampton, "the project compelled Le Corbusier to think out his Purist architectural format at a new scale, and in so doing, he tackled for the first time the problem of evolving an appropriate modern form for the accomodation of a representative structure." Frampton (see note 82), p. ix.

87 For an analysis of the design process, see Jean-Louis Cohen, Le Corbusier et la mystique de l'URSS, Bruxelles-Liège, Pierre Margaga Editeur, 1987, pp. 87-116.

in the Cahiers d'Art, Le Corbusier distinguished between several types of wall surface: glass, stone, or mixed, pointing to the smooth surfaces envisioned.[88] The conception of the wall was further tied to Le Corbusier's new concept of *respiration exacte*, a heating and cooling system based on the circulation of air in a closed circuit within the building envelope. This wall system patented by Le Corbusier and Pierre Jeanneret was called *murs neutralisants*. In the Centrosoyus project, the *mur neutralisant* was to be made of a double layer of thin volcanic-stone slabs (tufa). In a lecture of 1929, Le Corbusier theorized his new conception of wall surfaces and revetment materials. "The facade is a *pan de verre*. However, since there is no need to have the four sides of the house glazed, I will build glass walls, stone walls (veneer, bricks, artificial products in cement or other materials), or mixed walls (small windows or glazing) distributed like portholes on the stone walls." (fig.125)[89] A theory of the modern wall Le Corbusier illustrated with the Centrosoyus project (fig.126).

Completed in 1935 -- after a building campaign that suffered long interruptions and material shortages -- the Centrosoyus project was not executed as planned.[90] The system of *respiration exacte* was abandoned in favor a more traditional heating system. The double-layer system of the *mur neutralisants* was replaced by a single-layer masonry wall infill. The infill was made of blocks of red tufa from the Caucasus [*tuf rouge du Caucase*] 40 cm thick, a thickness that far exceeded the stone slabs of the *mur neutralisants*.[91] According to Le Corbusier, the mass of the thick tufa blocks was sufficient to absorb the heat difference between the inside and the outside.[92] In this system, the tufa blocks

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88 Le Corbusier, "Maison de l'Union des Coopératives à Moscou", Cahiers d'Art, no. 4, 1929, n.p.: "leur enveloppe [les bâtiments] est réduite à des plans lisses (doubles membranes). Ces plans sont tout de verre, tout de pierre ou mixtes, suivant la destination des locaux." Cited in Cohen (see note 87), p. 110.
89 Le Corbusier, "Les Techniques sont l'assiette même du lyrisme", Précisions sur un état présent de l'architecture et de l'urbanisme, Paris, Crès, 1930, p. 56: "Le façade est un pan de verre. Mais, comme il n'y a nul besoin à ce que les quatre faces de la maison soient de verre, je construirai des pans de verre, des pans de pierre (placages, briques, produits artificiels de ciment ou autres) et des pans mixtes (petites fenêtres ou vitrages) clairsemés comme des hublots dans les pans de pierre."
90 For a review of the building campaign, see Cohen (see note 87), pp. 116 ff.
91 Boesiger (see note 80), p. 35.
92 Boesiger (see note 80), p. 35.

performed a triple function, serving at once as an external revetment, an infill, and an insulating material. In this project, Le Corbusier tried to turned the wall revetment into an infill material without major changes to the aesthetic of the envelope. But the smooth stone-slab surfaces envisioned in the original project were apparently superseded by the rougher texture of unpolished tufa blocks of the executed building.[93]

Modern techniques and natural materials

In parallel with the large-scale projects that renewed his conception of the liaison between structure and envelope, Le Corbusier worked on a few projects marked by the reintroduction of natural materials. The first of these was the maisons Loucheur project (1928). The Loucheur project proposed a system of paired dwellings separated by a masonry wall made of rough stone or brick that acted as party wall and main support. On either side of the party wall, two iron pilotis supported the floor and roof of the house cells.[94] According to Benton, Le Corbusier's adoption of a load-bearing masonry wall was his response to construction regulations regarding fire prevention, and a diplomatic gesture toward local building firms.[95] Recalling the experience of Pessac, Le Corbusier later noted in the first volume of the Oeuvre complète that this return to the use of local materials was a *stratagème diplomatique.*[96] This *mur diplomatique* was Le Corbusier's response to local builders who resisted the use of new building materials and methods. With the house raised on iron pilotis, the party wall made of brick or rough stone was left visible on the ground floor.

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93 In the caption that accompanies a photograph of the end wall of the Centrosoyus building, Le Corbusier underlines that the tuff block wall was supposed to be *ravalé lisse*. See Boesiger (see note 80), p. 41.

94 For a discussion of the role of the maisons Loucheur in the development of Le Corbusier's interest in metal construction, see chapter VI.

95 Benton, "La réponse de Le Corbusier à la loi Loucheur", in Le Corbusier, une encyclopédie, Paris, Editions du Centre Pompidou/CCI, 1987, p. 238. Elsewhere, Benton also writes that the adoption of a masonry wall to be built of local materials and by local craftmen was primarily conditioned by a clause in the law inserted under pressure from the Unions. Benton (see note 77), p. 65.

96 Le Corbusier, Pierre Jeanneret, Oeuvre complète 1910-1929, Zurich, Girsberger, 1937 (reprint, Zurich, Artemis, 1964), p. 199.

Le Corbusier's strategic adoption of local materials must, however, be assessed in light of his broader conception of the Loucheur house as an industrial product. Following a description of the window openings of the Loucheur project -- *pan de verre* or strip window -- Le Corbusier explained: "Around, as an envelope, as a lizard skin, sheets of zinc exploiting the technique of folded metal of the automobile industry offer the best solution to the draining of rain water."[97] Assessing the maisons Loucheur, Benton correctly insists on the contrast between the materials and technique advocated: "Here was a juxtaposition almost surreal in its implications -- a wall embodying peasant labour, craftsmanship and materials literally transfixing a box made of up-to-date prefabricated steel construction literally deposited off the back of a lorry."[98] In the Loucheur project, Le Corbusier was compelled to make concessions to local materials and builders. Making use of rough-stone masonry, he chose to highlight the contrast between natural and industrial materials. Benton explains the Loucheur project in terms of Le Corbusier's dual concern of the time: his interest in the industrialization of construction, and his growing obsession with natural materials and organic forms.[99] But in this project, Le Corbusier's interest for natural materials was decisively subsumed under the broader project of the industrialization of construction.

The design of the villa de Mandrot (1929-31) at Le Pradet near Toulon is further testimony of Le Corbusier's continuing concern for the use of industrial materials and techniques (fig.127). According to Benton, after having studied two projects based on steel-framed Loucheur type, Le Corbusier explored a solution based on the steel building system patented by the Société de construction métallique Fillod.[100] When it was finally decided to employ a local mason to build the house, Le Corbusier redesigned the project, combining rustic stone walls and plywood facings with industrially manufactured steel

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97 Le Corbusier, "Une cellule à l'échelle humaine", Précisions (see note 89), p. 95: "Autour, en épiderme, en carapace de 'lézard', des feuilles de zinc qui fournissent à l'écoulement des eaux pluviales les solutions impeccables du pliage des tôles dans les carrosseries d'automobiles."

98 Benton (see note 77), p. 65.

99 Benton (see note 95), p. 239.

100 Benton (see note 95), p. 239.

windows and segments of cement-rendered walls.[101] Yet in his description of the Maison de Mandrot in the Oeuvre complète, Le Corbusier argued that despite the use of traditional masonry, the house respected the "thesis" defended by the architect.[102]

The Swiss Pavilion: Industrial techniques and materials

Le Corbusier's new approach to materials was best embodied in the Swiss Pavilion (1930-33) of the Cité universitaire in Paris. A key building in Le Corbusier's production of the period, the Swiss Pavilion has been hailed as the architect's manifesto on the role of materials in modern architecture (fig.128). Most noted have been the rough-cast organic pilotis, as well as the curved shape and rough-stone masonry wall of the ancillary block, taken as proof of Le Corbusier's interest in natural forms and materials.

To understand the place of these materials and forms in the Swiss Pavilion, it is necessary to examine the conception and construction of the building as a whole. Central to the conception of the Pavilion is the structural system and mode of assembly adopted. Here Le Corbusier continued his experimentation with industrialized metal construction, begun in the late 1920s. The Swiss Pavilion was made with a standardized steel skeleton raised on a concrete platform, with a *pan de verre* on the south side and a more opaque facade on the north side. The technique adopted for the construction of the light steel skeleton was similar to that of the Immeuble Clarté.[103] The platform supporting the skeleton was made of steel H-beams buried in the concrete slab. Central to the conception of the Pavilion was the separation between the *gros oeuvre* and the *second oeuvre*, and the technique of *montage à sec*.[104] Contrary to the Immeuble Clarté -- entirely based on light dry-mounted industrial materials -- the Swiss Pavilion still employed masonry materials for the construction of the wall. But the use of masonry brick was limited to the

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101 Benton (see note 77), p. 65.
102 Boesiger (see note 80), p. 59.
103 For a comparison of the Pavillon Suisse with the Immeuble Clarté, see Sumi (see note 62), pp. 99-100.
104 Sumi (see note 62), p. 99.

wall infill and complemented by industrial finishes on the inside. Moreover, all the interior living cells were standardized, with interior partitions made of dry-mounted light industrialized materials.

The glass wall of the south facade contrasted with the opaque revetment of the two side walls and with the north facade, punctured with small square windows. The external revetment was itself a factory-made product: "The external revetment is made of artificial stone. This revetment is made of standard slabs 40 mm thick. These slabs are made at the factory with a special work bench. The slabs are reinforced with wire mesh; the mortar is made of ordinary cement with a coat of mortar combined with crushed stones. This coating is then polished with a millstone."[105] The rectangular slabs were affixed to the masonry walls by means of metal fastenings that did not require water-based binder. They were affixed following a pattern that created horizontal bands interrupted by string courses made of the same material. Conceived as one of the building's layers, the revetment material was -- like the steel frame, window elements, and light partition walls -- made at the factory (fig.129).

Swiss Pavilion: the rough-cast concrete pilotis

A key feature of the Swiss Pavilion were the rough cast concrete pilotis that lifted the main housing block. The design of the pilotis must be examined in light of the building's structural system: the industrialized metal frame. A study of the design process brings to light the connection between the steel frame and the concrete pilotis.[106] The initial project presented a slab raised on a single row of slender steel stilts. Both the raised housing slab and the ancillary block containing the vertical circulation were conceived with a metal

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[105] E. Menkès "Le Pavillon Suisse à la Cité Universitaire", Chantiers. Organe technique de l'Architecture d'Aujourd'hui, vol. 1, no. 1, January-February 1933, p. 5: "A l'extérieur il y a un revêtement de pierre artificielle. Ce revêtement est formé de plaques standard de 40mm. d'épaisseur. Ces plaques ont été fabriquées en usine à la table à secousse. Elles sont armées de métal déployé; le mortier est fait de ciment ordinaire et d'une couche de mortier de ciment et de pierre concassée. Cette couche forme revêtement et a été ensuite meulée à la pierre."

[106] For an analysis of the mutation of the structural pilotis, see Curtis (see note 76).

frame. After much criticism from the client's outside expert, who apparently suggested that the steel stilts be encased in concrete, Le Corbusier's atelier finally came up with an original solution: a double row of rough-cast concrete pilotis of a more organic shape. In addition to providing lateral stiffness, the concrete pilotis -- apparently referred to as the "dog-bone" -- offered sufficient thickness to disguise runs of piping with a massively sculptural effect (fig.130).[107] The reviewer of Chantiers duly noted the originality of the solution: "The reinforced-concrete posts that support the platform ... take a very peculiar form, the result of both economic concern and plastic research. These posts, different from one another due to differences in loads carried, have been cast with the same formwork. Their section is very similar to the section of bones in a skeleton."[108]

As Benton suggests, the design of the sculptural pilotis can be interpreted as Le Corbusier's pragmatic response to a technical problem of stability and rigidity raised by outside expert.[109] But the design of the pilotis must also be understood in light of Le Corbusier's continuing exploration of the possibilities offered by modern construction techniques. With the pilotis of the pavilion, Le Corbusier exploited both the plasticity and texture of concrete, highlighting the traces of its *mise en oeuvre*. But it was done by means of reusable formworks, testimony to Le Corbusier's continuing concern for the technique and economy of concrete construction. The metaphorical interpretation of the pilotis as an organic element -- "dog-bone" or skeleton -- might be viewed as highlighting the shift from Purism to Organicism. But it can hardly be framed in terms of a critique -- or symbolic rejection -- of the techniques and materials of industrialized construction.

Swiss Pavilion: the ancillary block

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107 Benton (see note 95), p. 180.

108 Menkès (see note 105), p. 9: "Les poteaux de béton armé qui supportent la plateforme... prennent une forme tout à fait particulière, dictée par le souci d'économie d'une part et par la recherche plastique d'autre part. Ces poteaux qui sont tous différents les uns des autres, à cause des charges différentes résultant de la pression des vents, ont tous été coulés avec le même coffrage. Leur section se rapproche beaucoup de la section des os dans un squelette."

109 Benton (see note 95), p. 180.

Another feature of the Swiss Pavilion that provoked association with Organicism was the curved rough-stone masonry wall of the ancillary block. First conceived as a steel-framed cubic block of the same height as the main housing unit, the ancillary block turned into a single-story building endowed with a curved masonry wall. The single-story ancillary block was open on two sides by large glass walls that contrasted with the curved end-wall in rough masonry (fig.131).

Focusing on the use of natural materials as the thread that connects the maisons Loucheur (1928), Errazuriz house (1930), the villa de Mandrot (1930-31), the Pavillon Suisse (1930-33), as well as Le Corbusier's own studio apartment rue Nungesser-et-Coli (1931-34), most reviewers assume the homogeneity of this practice. Yet it is important to stress the shift from the Loucheur project to the Swiss Pavilion. With the maisons Loucheur, Le Corbusier adopted rough stone as a diplomatic compromise. With the villa de Mandrot, the use of masonry became a practical alternative. With the Swiss Pavilion, the use of masonry was an intentional gesture aimed at contrasting natural with industrial materials and assemblage. Benton points to the villa de Mandrot as a precedent in which Le Corbusier explored a deliberate confrontation of the organic with the industrial, the curvilinear with the cubic.[110] Yet in the Mandrot project, the use of masonry construction was constitutive of the building structure itself. By contrast, in the Swiss Pavilion Le Corbusier turned the rough masonry wall into a pure aesthetic device. By then, Le Corbusier had come to explore the contrast, not the opposition between traditional and modern materials. Describing the materials employed in the Swiss Pavilion, Le Corbusier wrote: "Modern aesthetic by the use of sound materials: rough stone, reinforced concrete, revetment slabs in cement."[111] By then, Le Corbusier chose to emphasize not the confrontation but the conflation between natural and industrial materials.

[110] Benton (see note 95), p. 180.
[111] Boesiger (see note 80), p. 83: "Esthétique moderne par emploi de matériaux sains: meulières, béton armé, revêtement en dalles de ciment vibré."

In his introduction to the second volume of Le Corbusier's Oeuvre complète, Sigfried Giedion stressed that one of the key aspects of the architect's practice was his understanding of the relation of architecture to building materials.[112] For Giedion, Le Corbusier was able to bring out the expressive potential contained in materials: "the charm achieved by diversified structures, the juxtaposition of the smooth and the rough, of glass and walls, the strength that can emanate from natural materials once one knows how to use them correctly."[113] Commenting further on the Swiss Pavilion, Giedion compared the rough-stone wall to a living mosaic that contrasted with the smooth wall surfaces of the main block.[114]

Industrialized construction and external revetments

The innovative character of the Pavilion was well noted by contemporary reviewers. Despite his aversion to the aesthetic of the Pavilion, the reviewer of La Construction Moderne could not avoid a discussion of the industrial techniques advocated by Le Corbusier.[115] By contrast, the reviewer of the newly published Chantiers saw in the Swiss Pavilion the best illustration of the journal's technological orientation.[116] Presenting the journal's program in the same issue, the editor strongly argued for the necessary interdependence between the *art de bâtir* and the world of industry.[117] It is this connection that Le Corbusier chose to emphasize in his introduction to the second volume of the Oeuvre complète. Assessing his recent production as laboratories, he wrote: "A

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112 Giedion wrote: "A la faculté de concevoir analytiquement sa tâche, vient s'ajouter le rapport de l'architecture avec les matériaux. Ce rapport avec les matériaux constitue l'apport personnel de l'oeuvre de Le Corbusier." S. Giedion, "Préface aux oeuvres de Le Corbusier 1929-1934", in Boesiger (see note 80), p. 9.

113 Giedion (see note 112), p. 9: "le charme dû à des structures différentes, à la juxtaposition du poli et du rigueur, du verre et des murs, la force enfin qui peut émaner d'une matière naturelle, dès qu'on sait l'utiliser comme il convient."

114 Giedion wrote: "A la Cité Universitaire de Paris, le mur mitoyen en pierre non taillée se transforme en une vivante mosaïque et en un jeu de rapports avec la surface polie des parois..." Giedion (see note 112), p. 9.

115 J. Margerand, "Le pavillon Suisse à la Cité Universitaire de Paris", La Construction Moderne, vol. 49, no. 14, 31 December 1933, pp. 218-224.

116 Menkès (see note 105), pp. 4-9.

117 Menkès (see note 105), p. 2.

large part of architectural programs can be realized in the factory, dry assembled, with machines, with metal, with natural or artificial products; and the house will be transported in prefabricated elements and assembled on the building site."[118] By 1935, Le Corbusier was still adamant in his call for the industrialization of construction, a call advanced with the pointed slogan: "Industry must take over the building industry".[119]

Le Corbusier's projects of the early 1930s are conventionally presented in terms of his interest in organic forms and materials opposed to the machine aesthetic of the 1920s. Yet they must also be understood in terms of the technological shift from the reinforced-concrete to the metal frame, and the corollary search for the industrialization of construction. It is this shift that explains Le Corbusier's adoption of hard external revetments, and the corollary development of a specific aesthetic of the envelope. Le Corbusier's experimentation with metal-frame construction induced a change in his conception of the wall infill. With reinforced concrete, the entire building process was most often subsumed under the technique of masonry construction. With the wall made of bricks or cement blocks, the join of frame to infill was made with water-based binder. The adoption of the metal frame induced a change in the construction process and with it the status of the external revetment. The wall came to be conceived as a multi-layered envelope. In this system, the external revetment was considered another layer affixed to the composite wall.[120] Though triggered by the research on the metal frame and dry-mounted construction, this mode of revetment was rapidly adapted to reinforced-concrete construction.

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[118] Le Corbusier, "Introduction", in Boesiger (see note 80), p. 12: "Une grande part des programmes de l'architecture peut être réalisée en usine, "à sec", avec les machines, avec du métal, avec des produits naturels ou artificiels; et la maison sera alors transportée en éléments manufacturés et montée sur place par des monteurs."

[119] Le Corbusier, "Introduction", in Boesiger (see note 80), p. 12.

[120] In the Immeuble Wanner project of 1928, the wall sections of the metal frame building were to be covered with a stone revetment. Sumi (see note 62), folio 2.

Beginning with the Palace for the League of Nations' project of 1927, Le Corbusier was to experiment with patterns of revetment materials.[121] These patterns were all based on sequences of horizontal stripes made of rectangular slabs interrupted by string courses. Several projects of the period 1930-35 are illustrative of this approach: the residential buildings for Moscow designed in response to the "Ville verte" plan (1930) (fig.132), the project for an Immeuble locatif in Zurich (1932) (fig.133), and the Loucheur houses proposed in the context of the project for the Réorganisation agraire (1934) (fig.134). First developed in the context of his pursuit during the late 1920s of the industrialization of construction, Le Corbusier's adoption of hard revetment materials was to trigger the development of a new aesthetic of the envelope.

Conclusion

By the early 1930s, French architects had turned their attention to the use of revetment materials. The alternative offered by metal construction helped break up the formalist equation between the choice of a structural material and the definition of an architectural aesthetic, between material and aesthetic. The choice between steel and reinforced concrete encouraged the emergence of a new relativism in the apprehension of structural materials. This relativism of structural systems developed in parallel with a new interest in the material expression of the building envelope. Moving away from the monochromatic, uniform, and abstract surfaces of the 1920s, many architects rediscovered the expressive potential of infill and/or revetment materials. The dematerialization of construction, the reduction of walls to surfaces, achieved during the 1920s gave way to an increased attention to the materiality of external envelopes. It is this renewed attention to the nature of building materials that soon occupied the center of an ideological controversy on materials and modernism.

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121 According to Frampton, the skin revetment of the Centrosoyus, be it stone or glass, and its "general horizontal coursing capped by string course", evoked classical syntax. Frampton (see note 82), p. xxi.

3. On the Ideology of Materials in French Modernism

In a conference given in March 1932, Gustave Umbdenstock -- professor at the Ecole Polytechnique and chef d'atelier at the Ecole des beaux-arts -- launched a vehement critique of French modern architecture.[122] Formulated before representatives of the Chambres de Commerce, his critique of the modern movement was argued in terms of the defence of traditional French architecture and of both small-scale industry and traditional craftsmanship. It was not his first intervention on the subject, for in October 1931 Umbdenstock had already developed this thesis in a lecture on the evolution of twentieth-century architecture.[123]

For Umbdenstock, modern architecture was at the root of the downfall of French architecture and of the French building industry. From the outset, he severely criticized the smooth surfaces of French modern architecture. Paying special attention to the issue of building materials, he formulated a staunch critique of modern building techniques, arguing that steel and reinforced concrete had brought the downfall not only of stone cutters but also of woodworkers, roofers, plumbers, masons, carpenters, and decorators.[124] In his view, this downfall was due to the privileging of reinforced-concrete over stone construction. For Umbdenstock, the use of stone -- a material that came from the French soil -- was key to the survival of French architecture. To reverse this trend, he felt necessary to launch a crusade in favor of stone:

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[122] Gustave Umbdenstock, "La défense des métiers de main des artistes et artisans français", lecture given at the salle Wagram, 14 March 1932. Excerpts of the lecture were published in L'Architecture, vol. 45, 15 March 1932, pp. 134-138. For a description of the event, see Maximilien Gauthier, "Le manifeste de l'UAM", L'Art Vivant, August 1934. Though partly indebted to Jean-Claude Vigato's analysis of the 1930s campaign against modern architecture, the present section focuses on different issues. J.-C. Vigato, "Le jeu des modèles. Les modèles en jeu", 2 vol., CEMPA-Ecole d'architecture de Nancy, 1980.

[123] G. Umbdenstock, L'évolution architecturale au XXe siècle (lecture given at the Rotary-Club 21 October 1931), Paris, Imprimerie A. Tournon, 1932. See also Umbdenstock's articles in Art National, and La lutte contre le chômage. La défense des qualités artistiques françaises, Paris, Photopresse, n.d. [1935].

[124] Umbdenstock, cited in Le Corbusier, Croisade ou le Crépuscule des Académies, Paris, Crès, 1933, p. 82.

> To conclude, it seems that the cult of stone is a fundamental principle of which we must become convinced advocates. It is imperative to launch a crusade that would call upon stone craftsmen, and give them the means to contributed to the renaissance of stonework. All Frenchmen have the duty to protect stone workers (sculptor, stone cutter, masons) and provide them with the opportunity and means to express their talent and ensure their existence.[125]

Umbdenstock further called for the adoption of new regulations that would compel architects to use traditional masonry walls 50 cm thick.[126] Made of stone, rubble stone, granite, brick, or even shingle, these masonry walls would provide a moral and tangible guarantee for the anchoring of buildings to the ground -- a moral attachment to the ground framed as an overt critique of the Corbusean practice of raising buildings on pilotis.

Umbdenstock's critique of modern architecture and modern building practices had broad implications, first for the culture and the know-how of builders and craftsmen. For Umbdenstock, the defence of stone construction was a means to express national solidarity. As such, his critique had political and ideological implications, for it addressed the current crisis in French society due to the global economic crisis. As a remedy to this employment crisis, Umbdenstock proposed a model of organization which recalled the medieval corporations.

The building industry was not the only field sensitive to Umbdenstock's call for the defence of traditional craftsmanship. The domain of the decorative arts provided a fertile ground for the development of these ideas. Among Umbdenstock's allies was the interior decorator Paul Iribe. Already in 1930, Iribe had called for the protection of the luxury industry against the influence of a rationalism that eliminated all ornaments and thus, all craft work.[127] "Iribe insisted on the fact that the fashion for the cube was an incursion of

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125 Umbdenstock, cited in Croisade (see note 124), p. 82: "Pour conclure, il semble que le culte de la pierre soit un principe fondamental dont nous devons devenir les apôtres convaincus et qu'une croisade s'impose aujourd'hui pour faire appel aux artisans du ciseau, en leur procurant les moyens de contribuer à la renaissance actuelle qu'en aucun cas nous ne devons laisser péricliter. Tous les Français on le devoir de se solidariser pour protéger les travailleurs de la pierre (sculpteurs, tailleurs de pierre, maçons) et leur fournir l'occasion et les moyens d'exprimer leur talent en assurant leur existence."

126 Umbdenstock, cited in Croisade (see note 124), p. 84.

127 Paul Iribe, Choix, Paris, Draeger, 1930. On this issue, see Sizanne Tise, "Manifeste 1934", Les Années UAM 1929-1958, Paris, Musée des Arts Décoratifs, 1988, p. 106.

the *americano-germano-soviets*, situated at the opposite side of the French traditions based on the formal expression of the *arabesque*."[128] The 1932 exhibition of the Union des Artistes Modernes (UAM) offered a good occasion to resume the attack on modern art. In a lecture given before the Corporations du bâtiment in February 1932, Iribe reiterated his critique of the modernist trend in the French decorative arts.[129] This time, his defence of the French luxury industry and of French craftsmen was coupled with a denunciation of universal machinism and of Swiss (Le Corbusier) and German (Gropius) influences. In L'Entreprise française -- the official journal of the Fédération nationale du bâtiment et des travaux publics -- Thiébault-Sisson denounced the infiltration of Soviet propaganda in France.[130] Formulated at a time of aggravation of the economic crisis, these critiques were concerted attacks against modern forms and industrial methods of production.

Mauclair and the campaign against Modern Architecture (1933)

A key argument raised by both Umbdenstock and Iribe against modern architecture and decorative arts was the "nudism" advocated by its protagonists. The notion of "nudism" was first formulated by the art critic Camille Mauclair during his campaign against modern architecture started in 1929.[131] Mauclair was against the stripped surfaces proposed by new architectural conceptions. By then, Mauclair approached the critique of "nudism" in terms of the rejection of internationalist influences on French architecture.[132] First formulated in 1929, the critique of "nudism" was soon to become a key argument in

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128 Tise (see note 127), p. 106.

129 The February 1932 lecture was organized by the Ligue de l'Art Décoratif Français. See Paul Iribe, "La marque France", in Défense du luxe, Paris, Draeger, 1932.

130 Thiébault-Sisson, "A propos du Salon de l'Union des Artistes", L'Entreprise française, 25 February 1932, pp. 9-10.

131 François Fosca, "A propos d'une campagne contre l'art moderne", L'Amour de l'Art, vol. 10, no. 6, June 1929, p. 239. On this issue, see Tise (see note 127), p. 84.

132 The notion of "nudism" was rapidly used in the field of the decorative arts as a negative qualifyer for the smooth surfaces of the new metal furniture. See Ernest Tisserand, "Le meuble de métal et son avenir", L'Amour de l'Art, vol. 10, no. 11, November 1929, pp. 418-427; François Fosca, "Encore le meuble de métal", L'Amour de l'Art, vol. 11, no. 1, January 1930, p. 55.

the second campaign against French modernism launched by Mauclair in 1933, at the peak of the economic crisis that struck France in the early 1930s.[133] First published in Le Figaro, Mauclair's articles were republished in several other journals.[134] They were also published in book form in 1933.[135]

In the series of articles published between January and April 1933, Mauclair developed a critique of French modernism enshrined in the undecorated cubic house in concrete of the 1920s. From the outset, Mauclair pounced on Le Corbusier as the key protagonist of the new architecture in France, presenting him as both an agent of international Communism and the *Picasso du béton.*[136] Le Corbusier and other modernists were to be criticized for their dogmatic use of concrete: "Idolatrous of concrete -- a material that has great merits but that also favors architectural speculations -- they do not permit this material to be used in conjunction with stone and wood, as is proposed by moderate technicians."[137] In his critique of modernism, Mauclair vehemently denounced the domination of concrete in French architecture. This critique of concrete was directly linked to the issue regarding the nakedness of building surfaces, to "architectural nudism". In the article entitled "L'affreux nudisme", Mauclair reflected on the impact of concrete on the building industry: "I cannot decide if the day laborer who pours concrete in a mold is more or less intelligent than the stone cutter, inheritor of a long and glorious tradition of craftsmanship. But what I know is that 'nudism' is a

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133 Camille Mauclair, "L'architecture bolchévisante" and "L'affreux nudisme", Le Figaro, January 1933; "Mort de l'architecture 'inutile'", Le Figaro, 2 February 1933; "La grande pitié de l'architecture 'moderne'", Le Figaro, 8 April 1933.

134 Mauclair's articles were republished in L'Architecture, Art National Construction, and L'Ami du Peuple.

135 Camille Mauclair, L'architecture va-t-elle mourir ?, Paris, Editions de la Nouvelle Revue Critique, 1933.

136 Mauclair, "L'architecture bolchévisante", L'architecture, vol. 46, no. 3, 15 March 1933, p. 82.

137 Mauclair, "La grande pitié de l'architecture 'moderne'", Le Figaro, 8 April 1933: "Idolâtres du ciment, dont nul ne nie les mérites mais qui favorise d'énormes spéculations, ils n'admettent même pas qu'on puisse, conjointement à ce matériau mirifique, continuer à user de la pierre ou du bois comme le proposent les techniciens modérés."

disaster for the many trades it deprives of work...."[138] He acknowledged that the material had certain qualities, but strongly disagreed with its exclusive use.[139] He further compared the making of concrete to a cooking operation, in an attempt to give the material a negative connotation.[140] Interpreting the widespread use of concrete as a plot hatched by internal merchants, Mauclair targeted this material as the source of the problems of the French building industry. In fact, Mauclair's condemnation of both concrete and modern architects was punctuated by arguments which reflected the ideological progression of the extreme right. In a context of economic crisis, modern architecture became the target of anti-bolshevism and anti-capitalism. A critique of communism and international capitalism that led to the valorization of corporatism and craft production.[141]

In his diatribe against concrete, Mauclair was not oblivious to the current positions within French architecture itself. Since most architects involved in the renewal of French architecture had been advocates of reinforced-concrete construction, his stigmatization of concrete was problematic. Considering the widespread use of concrete in current architectural production, Mauclair was forced to distinguish between the right and the wrong, the acceptable and unacceptable use of the material. He thus praised Perret, Laprade, Prost, Marrast, Roux-Spitz, opposing them to Le Corbusier and the like: Lurçat, Mallet-Stevens, Pingusson, Fischer.[142] With Mauclair, the negative connotation attached to concrete construction applied only to the internationalist trend of French modernism.

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138 Mauclair, "L'affreux nudisme", L'Architecture, vol. 46, no. 3, 15 March 1933, p. 83: "Je ne saurais décider si le manoeuvre qui coule du béton dans un moule est plus ou moins intelligent qu'un tailleur de pierres, héritier d'un long et glorieux passé d'artisanat. Mais ce que je sais, c'est que le nudisme est un désastre pour plusieurs corporations auxquelles il ôte leur travail..."

139 Mauclair, "Pour la défense des ouvriers d'art", L'Ami du peuple, 9 April 1933.

140 He wrote: "Rien que la pâte à crêpes, versée dans les gaufriers du nudisme !". Mauclair (see note 139).

141 On Mauclair's ideological program, see Vigato (see note 122), pp. 169 ff.

142 Mauclair, "La grande pitié de l'architecture 'moderne'", Le Figaro, 8 April 1933. See also René Drouin, "Enquête sur l'architecture moderne", L'Architecture d'Aujourd'hui, vol. 3, no. 4, May 1933, pp. 3-4.

Perret and the praise of traditional craftsmanship

The campaign led by Umbdenstock and Mauclair had a major impact on French architectural culture, compelling the main protagonists of the architectural scene to take a stance in the dispute. From the outset, Auguste Perret became at once a protagonist and a reference point in the debate. The most tangible result of Umbdenstock's campaign was the creation of the Groupement corporatif des artistes, artisans et maîtres de métiers français, a group established to defend traditional craftsmanship in the building industry. The Groupement, which solicited the support of a number of architects and art critics, included Perret as one of its patrons.[143] Presided over by Louis Hourticq -- a member of the Institut -- the Groupement engaged in a campaign in favor of traditional architecture and the use of "national stone" in the building industry. In his praise of stone, Hourticq did not hesitate to attack reinforced-concrete construction. As a vocal advocate of reinforced-concrete, Perret was placed from the start in an ambiguous position that was duly noted by a reviewer of the association's meeting. For Paul Fierens, it was difficult to conceive that an association endorsed by eminent architects like Perret and Roux-Spitz be against the use of reinforced concrete, a French invention that permitted the harmonious and economical solution of a number of architectural problems.[144] Fierens further added: "The question 'stone or concrete' is no more valid in our time than the question 'fresco or oil painting' at the beginning of the 15th century. Each material possesses its particularities, its utility, its nobility."[145]

Yet at the time of this controversy, Perret himself appeared to be sensitive to the reintegration of traditional decorative practices in architecture. Interviewed on the possibility of using mural (fresco) painting in architecture, Perret responded: "Maybe no architecture has ever been better suited than ours to the collaboration of the painter. I

143 See Perret's correspondance with the "Groupement corporatif des artistes, artisans et maîtres de métiers" (Fonds Perret, 535 AP 321).

144 Paul Fierens, "Pierre ou béton ?", Journal des débats, 2 December 1932. (Fonds Perret, 535 AP 334).

145 Fierens (see note 144): "La question 'pierre ou béton' ne se pose pas plus, à notre époque, que ne se posait, au début du quinzième siècle, la question 'fresque ou peinture à l'huile ?' Chaque matière a ses exigences, son utilité, sa noblesse."

would add that this collaboration seems to me not only desirable but necessary."[146] Perret wished to see mural painting itself become a *matériau*, "maybe the richest and most beautiful of all revetment materials." Perret's response was formulated in the context of an investigation on the "crisis of the plastic arts" conducted among well-known French architects.[147]

In a 1933 lecture, Perret further developed his position on the current debate on materials and ornaments.[148] For Perret, reinforced-concrete architecture offered the best support for traditional sculpture and painting: "This architecture based on a large structural skeleton with infills is the ideal frame for sculpture and painting, which will become more and more necessary to restore the human dimension to buildings constructed with the help of powerful machines, buildings that are more the product of machines then of Men."[149] Perret's concern for the issue of ornaments in architecture was not new. From the early 1910s, the question of ornament had played a key role in the gradual formulation of his architectural doctrine. At the time of the Champs-Elysées theater, Perret was able to define the principles of a "style without ornaments" that viewed nudity as an attribute of artistic beauty. By the early 1930s, however, Perret had come to give the term "nudity" a negative connotation. Perret did not accept the Beaux-Arts conception of ornaments as "applied elements", but he warmly accepted the idea that

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[146] Angel Zarraga, "La peinture à fresque doit être un 'matériau' nous dit M. Auguste Perret", Excelsior, 28 December 1932: "Aucune architecture, peut-être, n'a été mieux faite que la nôtre pour la collaboration du peintre. Je dirai même que cette collaboration me semble non seulement souhaitable , mais nécessaire."

[147] The architects interviewed were Perret, Mallet-Stevens, Siclis, Laprade, Ventre, Le Corbusier, Tournon, Pacon, Patout, and Marrast. Angel Zarraga, "Une solution à la crise des Arts plastiques. Notre enquête auprès des architectes sur les possibilités d'une renaissance du travail d'équipe", Excelsior, 28-29-30 December 1932.

[148] Auguste Perret, "L'architecture", lecture given 31 May 1933 at the Institut d'Art et d'Archéologie before the Association pour l'étude des arts. The same argument was developed in the article "Construction. Architecture" published in La Journée industrielle, 15 June 1933. The text of the lecture was published in Revue d'Art et d'Esthétique, no. 1-2, June 1935, pp. 41-50.

[149] Perret, Revue d'Art et d'Esthétique (see note 148), p. 50: "Cette architecture de grande charpenterie avec remplissage est un cadre tout préparé pour la sculpture et la peinture qui, à mon avis, deviendront de plus en plus nécessaires pour remettre à l'échelle humaine, des édifices qui, construits à l'aide de puissantes machines, sont plus les fils de ces machines que ceux de l'Homme."

traditional decorative practices such as painting and sculpture be used to adorn buildings as long as their structure remained legible.[150]

Perret's rejection of the conspicuous "nudity" of modern architecture echoed the campaign against the "new formalism" that unfolded in the pages of L'Architecture d'Aujourd'hui.[151] Making use of Frank Lloyd Wright's discourse on "the meaning of materials" published in 1928 in Architectural Record, the campaign inaugurated by Marie Dormoy focused on the bare surfaces of the new architecture as a manifestation of a new ornamental practice.[152] Dormoy considered the ornament as something that could be beautiful, but only if it was used logically.[153] For his part, André Bloc -- the editor of L'Architecture d'Aujourd'hui -- argued against "architectural nudism", defending the rational use of ornament.[154] Perret's reflections of 1933 on the role of ornament were also related to ongoing discussions on the issue of ornamentation in art and architecture.[155] In spring 1933, the art critic Georges Brunon-Guardia had launched an investigation on ornament in Beaux-Arts.[156] In April 1933, the journal Art et Décoration had begun its own investigation on the theme "Evolution or death of the ornament ?"[157]

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150 On this issue, see chapter II. See also Roberto Gargiani, Auguste Perret (1874-1954). Teoria e opere, Milan, Electa, 1993, pp. 208 ff.

151 Marie Dormoy, "Contre le nouveau formalisme", L'Architecture d'Aujourd'hui, vol. 2, no. 9, December 1931-January 1932, pp. 4-6; André Bloc, "La question de l'ornement", L'Architecture d'Aujourd'hui, vol. 3, no. 1, January-February 1932, pp. 3-5; M. Roux-Spitz, "Contre le nouveau formalisme", L'Architecture d'Aujourd'hui, vol. 3, no. 3, April 1932, pp. 61-63.

152 Frank Lloyd Wright, "Idées sur l'architecture", L'Architecture d'Aujourd'hui, vol. 2, no. 9, December 1931-January 1932, pp. 3-4. Frank Lloyd Wright wrote: "En effet, si vous regardez en dessous de la surface toute moderne qu'elle soit, vous retrouverez le style purement ornemental." (p. 3).

153 Dormoy wrote: "N'aurait-on bafoué l'ornement, -- qui peut être une si belle chose employé logiquement, -- que pour faire, de la nudité même, un ornement ?" Dormoy, (see note 151), p. 6.

154 Bloc (see note 151), p. 3.

155 Perret wrote: "On parle beaucoup en ce moment de l'ornement. Une enquête vient de se terminer au journal Beaux-Arts, une autre est en cours à l'Art Décoratif." Perret, "Construction. Architecture", La Journée industrielle, 15 June 1933.

156 Launched in spring 1933, the investigation tounched upon the issue of architecture in April and May 1933. Georges Brunon-Guardia, "Pour ou contre l'ornement ?", Beaux-Arts, vol. 72, no. 15, 14 April 1933, p. 2; no. 16, 21 April 1933, p. 2; no. 19, 12 May 1933, p. 2; no. 20, 19 May 1933, p. 2.

157 Fabien Sollar, "Enquête. Evolution ou mort de l'ornement ?", Art et Décoration, May 1933, pp. i-iv; June 1933, pp. v-vii; July 1933, pp. i-vi; September 1933, pp. i-vii; October 1933, pp. i-v; November 1933, pp. i-ii.

Strategic excerpts of these investigations were published in L'Architecture and L'Architecture d'Aujourd'hui.[158]

In early 1932, the conception of ornament defended by Perret was still focused on the expression of building materials. Yet by 1933, thanks to the impact of Umbdenstock's campaign, Perret was ready to emphasize the role of traditional decorative practices in contemporary architecture. Perret's acceptance of the arguments put forth by Umbdenstock and the Groupement was best illustrated by his project for the new Trocadéro of the 1937 International exhibition (fig.135). The project presented to the minister of culture Anatole de Monzie was conceived in the summer of 1933. While the entire building was based on a reinforced-concrete structure, Perret proposed a conspicuous use of stone, and stone-based (low relief) decoration. Commenting on the unexecuted project, Emmanuel de Thubert wrote: "One of the merits of the project is that it puts an end to the debate between the advocates of stone and of cement. The project is effectively made of a reinforced-concrete skeleton, but the infill is made of stone, and true stones at that."[159] Central, to this reviewer, was the nature of the stone infill. He stressed that the infill was not made of thin slabs fixed with metal pins, acting as a mere revetment, but of real stone panels 7 cm thick fixed within a frame, and thus playing a constructional role.[160] For de Thubert, Perret's project was a proof that architecture could take the direction of the plastic arts, especially the arts that made use of wall surfaces, like sculpture and painting.

Perret's new conception of the marriage between concrete and stone was made clear in an interview of December 1933.[161] Responding to the ideas defended by Mauclair,

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158 [Anonymous], "Pour ou contre l'ornement", L'Architecture, 15 June 1933, p. 178; [Anonymous], "Evolution ou mort de l'ornement. Une enquête des échos d'art", L'Architecture d'Aujourd'hui, vol. 3, no. 6, July-August 1933, pp. 95-96.

159 Emmanuel de Thubert, "L'Exposition de 1937 - Fille de Jaïre", La Construction Moderne, vol. 49, no. 36, 3 June 1934, pp. 613: "Autre mérite et non le moindre: la construction, dans cet admirable projet, vient clore le débat qui partage encore les gens de la pierre et ceux du ciment. Elle est bien faite d'une ossature de béton, mais c'est à la pierre qu'elle demande son remplissage et à de véritables pierres."

160 De Thubert (see note 159), p. 613, note 5. At the time, Emmanuel de Thubert was president of the Société des Architectes Modernes.

161 A. Perret, in "Le béton de ciment armé dans les constructions", République, 24 December 1933.

Perret argued that it was incorrect to oppose concrete to stone, to oppose the workers of concrete to the stone cutters, and to attribute the current unemployment of stone cutters to the development of reinforced-concrete construction. He stressed that reinforced-concrete was an invention that was truly French, and that its abandonment would be a move backward. Perret envisioned the issue in terms of the complementarity between the two materials: "Concrete is not opposed to stone and does not exclude stone. On the contrary, a skeleton, a frame in reinforced concrete must and can be constituted with an infill made of stone from France, in which stone is not considered as a load-bearing material but as an infill or a revetment."[162] For Perret, the solution resided in the sensible and intelligent understanding of the possibilities of the two materials, with the future of stone-related corporations and trades depending on the continuous development of reinforced-concrete architecture. By 1933, Perret had finally achieved the reconciliation between the modernity of concrete construction with the traditional craft practices of stone cutting and architectural ornamentation.

Le Corbusier and the critique of traditional craftsmanship

Umbdenstock's and Mauclair's diatribes against modernism encouraged the framing of French architectural culture in terms of the division between the nationalist and the internationalist camps. Their diatribes unfolded at a time of heightened interest in the debate on and definition of modern architecture. In December 1931, an "evening of propaganda" organized by L'Architecture d'Aujourd'hui became the scene of the confrontation between two competing definitions of modernism.[163] It was in this heated context that Robert Mallet-Stevens -- the new president of the Union des Artistes

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[162] Perret (see note 161): "Le béton de s'oppose pas à la pierre et n'exclut pas la pierre, mais au contraire, un squelette, une ossature de béton armé, doit et peut comporter un remplissage de pierre de France qui ne doit plus être considéré comme un matériau portant, mais comme un matériau de remplissage ou de revêtement.

[163] See [Anonymous], "La soirée de propagande de l'Architecture d'Aujourd'hui", L'Architecture d'Aujourd'hui, vol. 2, no. 9, December 1931-January 1932, pp. 77-83. A participant in this confrontation, Henri Sauvage insisted on portraying modern architecture as the triumph of the naked wall (pp. 78-81).

Modernes -- responded to Umbdenstock. For Mallet-Stevens and the UAM, the campaign was directed against modern art in general, and modern architecture in particular.[164] Noting that Umbdenstock's campaign was conceived as a defense of French art, Mallet-Stevens demanded what prevented modern art from being French.[165]

The most elaborate response to Umbdenstock's campaign was, however, proposed by Le Corbusier with his Croisade ou le Crépuscule des Académies, published in September 1933.[166] Though Croisade addressed Umbdenstock's arguments, it also included a response to Mauclair's campaign *anti-Lecorbusique*. From the outset, Le Corbusier argued that the early 1930s were a period that, because of the unprecedented violence of the contemporary mechanical and scientific world, proposed and imposed constructions that were entirely new.[167] It was these changes that undermined the ideological opposition between stone and concrete. Rejecting Umbdenstock's call to build with traditional masonry walls anchored to the ground, Le Corbusier insisted on the need to acknowledge that modern houses were to rest on steel or concrete skeletons. Since reinforced-concrete was an established material of the modern building industry, Le Corbusier pointed to the need to reconsider the stone trade and its craft tradition. He proposed that instead of selling stone by the cubic meter, quarries should deliver stone by the square meter. The production of thin stone slabs rather than thick stone blocks responded to the changes that had occurred in the conception of the wall. Insisting on the new status of stone as primarily a building revetment, he added: "the sound of the stone saw will replace the joyous sound of the hammer, and since this labour will be done by

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164 Robert Mallet-Stevens, "Défense de l'architecture et de la décoration moderne", L'Intransigeant, 1932; "Architecture Moderne", L'Architecture d'Aujourd'hui, vol. 3, no. 8, 1932.

165 The quarrel between Mallet-Stevens and Umbdenstock was closely followed in the architectural press. See Gabriel Imbert's series of articles in Le Bâtiment Illustré: "La querelle des anciens et des modernes": "III. Les discussions d'école et l'opinion publique", vol. 20, no. 6, June 1932, pp. 13-14; "IV. 'La défense de l'Architecture et de la Décoration moderne'", no. 7, July 1932, p. 11; "Le cri d'alarme du 'Bâtiment Français'", no. 9, September 1932, p. 7.

166 Le Corbusier, Croisade ou le Crépuscule des Académies (see note 124). In a footnote, Le Corbusier mentions that the proofs were ready in January 1933.

167 Le Corbusier, Croisade (see note 124), p. 13.

the quarryman, stone will become again the normal skin of numerous constructions."[168] Reversing Umbdenstock's argument, Le Corbusier attempted to show how the stone trades could survive despite major changes in the construction process. Defending the craftsmen against the Chamber of Commerce, he pointed to the fact that the future rested entirely in the hands of the trade corporations.[169]

Unexpectedly, Le Corbusier also added that he was in agreement with Umbdenstock on the fact that stone was more attractive than coating. The reason invoked was economical: "'Modern' architecture is generally covered with coatings and not of stone, because modern architects only have modest commissions endowed with limited budgets. They prefer to use their budget to equip the interior and they accept -- grieving inwardly -- to revest the raiment of the poor: the coating."[170] This avowal was not new, for already in 1932 he had admitted that the use of cement coating was mostly due to tight budgets, and that if money permitted he could consider using revetment materials like ceramics and mosaics.[171] Insisting on the economic dimension of the use of coating, Le Corbusier seemed to minimize the aesthetic function performed by homogeneous revetments. Was this a reversal of the Purist position that praised the morality of whitewash? Not really, for he stressed that coating, and especially whitewash, was decent, admissible, and at times admirable.[172] Yet by 1933, the stone slab had apparently become one of Le Corbusier's preferred revetment materials, its extensive use only limited by questions of cost. Hard stone could even be replaced by marble, as shown in

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[168] Le Corbusier, Croisade (see note 124), p. 28: "le bruit des scies remplacera le son joyeux du marteau et cet effort étant réalisé par les carriers, la pierre redeviendra le normal épiderme de nombreuses constructions."

[169] Le Corbusier, Croisade (see note 124), p. 30: "Conclusion: Chambre de Commerces des carriers: prière de nous vendre à bon marché de la pierre *en feuilles*." On this issue, see Vigato (see note 122), p. 174.

[170] Le Corbusier, Croisade (see note 124), p. 30: "L'architecture "moderne", généralement, est recouverte d'enduits et non de pierre, parce que les architectes modernes ne reçoivent que des commandes modestes réglées par des budgets de famine. Ils préfèrent employer leur budget à équiper l'intérieur et ils consentent -- la mort dans l'âme -- à revetir la défroque du pauvre: l'enduit".

[171] Angel Zarraga, "M. Le Corbusier envisage la question des matériaux colorés de revêtement", Excelsior, 29 December 1932.

[172] Le Corbusier, Croisade (see note 124), p. 30.

Le Corbusier's project of 1936 for the proposed revetment of the villa at Garches (fig.136).

A manifesto on the play of materials (1934)

In Croisade, Le Corbusier did not hesitate to point to the beauty of stone revetments.[173] He also pointed to the beauty of natural materials, writing under an illustration of the villa de Mandrot: "this beautiful stone of Provence, orange, and all spangled with crystals...."[174] This praise of natural stone was not unrelated to the current conception of materials propounded by the Union des Artistes Modernes, of which he was a member. Founded in 1929, the UAM regrouped architects, interior decorators, sculptors, graphic designers, and furniture designers around the goal of promoting forms adapted to modern living. Published in July 1934, the manifesto of the UAM was commissioned in December 1932 as a means to respond, point by point, to the accusations advanced by the protagonists of the campaign against modern art.[175]

From the outset, the manifesto addressed the issue of the function and future of ornament.[176] Responding to the accusation of "nudism", the manifesto questionned the conception of clothing, of revetment, defended by the detractors of modern art. By contrast, the manifesto insisted on the importance of the form over the ornament. Stressing that beauty first resided in the form, it underlined that pure form was more difficult to achieve than decorated form, where the ornament could be employed to conceal defects. For the members of UAM, a determinant factor in the aesthetic of modern works was the play of materials. Of all the pleasures offered by works of art, it was to the play of materials that modern man was becoming more and more sensitive.

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[173] Le Corbusier, Croisade (see note 124), p. 30: "Mais si nos budgets deviennent plus larges, la pierre qui est, en effet, si belle, réapparaîtra".
[174] Le Corbusier, Croisade (see note 124), caption of the illustration, n.p.: "cette belle pierre de provence, orange et toute paillettée de cristaux..."
[175] Tise, "Manifeste 1934" (see note 127), pp. 105-108.
[176] "Pour l'art moderne. Cadre de la vie contemporaine", in Les Années UAM 1929-1958, Paris, Musée des Arts Décoratifs, 1988, pp. 39-61.

According to this emphatic aesthetic, materials could generate physical delectation and pure sensuous joy.

Contrasting the various attitudes towards materials encountered in art-historical periods, the manifesto explained that the contemporary period was open to all *matières*: "Classicism only believed in noble materials, romanticism dreamed of ancient materials, naturalism reveled in using indigenous materials, and symbolism revealed rare materials; no other period but ours has loved all materials without exception, for themselves, for their quality, for their resistance to the tools of the artist."[177] Questioning the notion of "traditional material", the manifesto rejected the common critique uttered against steel and concrete. Arguing that each building material had given birth to a style closely linked with its physical possibilities, it demanded that steel and concrete be accorded the right of personal expression. The manifesto further questioned the notion of "beautiful material". "A beautiful material is not necessarily rare or precious. It is first of all a material that, thanks to its natural or industrial texture, gives pleasure to the eye and the touch, and that is enhanced by a judicious use."[178] According to this definition, the grain of wood, the shine of brushed steel, the weft of a textile, the imperfection of glass are considered intrinsic qualities of the material. Abolishing the value-laden distinction between natural and artificial, the UAM manifesto proposed a genuine theory of materials in modern art. A theory that focused on the texture of materials as a key element in the aesthetic of modern forms.

Le Corbusier and the development of "technological architecture"

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[177] "Pour l'art moderne" (see note 176), p. 57: "Le classicisme croyait aux seules matières nobles, le romantisme rêva des anciennes, le naturalisme se complut aux matières pauvres et honteuses et le symbolisme révéla les rares; cependant aucune époque n'a aimé comme la nôtre toutes les matières sans exception, pour elles-mêmes, pour leur nature, pour leur rébellion à l'instrument de l'artiste."

[178] "Pour l'art moderne" (see note 176), p. 58: "Et ensuite, qu'est-ce qu'une 'belle matière'? Une belle matière n'est pas forcément rare ou précieuse. C'est avant tout une matière dont les jeux naturels ou la contexture industrielle procurent une joie au regard, au toucher, et qu'un judicieux emploi valorise.

Le Corbusier shared the conception of materials proposed by the UAM. But his approach to materials was also intimately integrated within the continuous project of the industrialization of construction. In the second volume of the Oeuvre complète published in 1935, Le Corbusier was still adamant in his call for the industrialization of construction, demanding that "Industry take over the building industry."[179] For this industrialization process, he had decisively shifted attention from reinforced-concrete to steel construction: "Steel is the best material, destined to be used under a variety of forms in the construction and equipment of the house, and consequently of houses and cities."[180] Central to his conception of industrialization and *montage à sec* was the new nature of the wall as a thin membrane, a membrane constructed with the manufactured materials made available by modern industry: "Modern industry offers us manufactured artificial materials of fundamental importance: steel sheet, wood sheet (plywood of all thickness), cement sheet (fibro-cement, etc...), cork sheet, cardboard sheet, etc..."[181]

For the editor of Chantiers, a technical journal launched by L'Architecture d'Aujourd'hui in 1933, the understanding of the new condition of the building industry was essential for the development of contemporary architecture.[182] Questioning the tendency of modern architects to romanticize the "adventure of machinism", the editor insisted on the need to carefully examine the new technical possibilities and limitations imposed upon architectural production. For Chantiers, the development of the art of building was, however, irremediably linked with the world of industry.[183]

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179 Le Corbusier, "Un nouvel ordre de grandeur des éléments urbains, une nouvelle unité d'habitation", in Boesiger (see note 80), p. 110.

180 Boesiger (see note 80), p. 112: "L'acier est le matériau par excellence destiné à être employé sous un nombre infini de formes dans la construction et l'équipement des logis, par conséquent des maisons et des villes."

181 Boesiger (see note 80), p. 113: "L'industrie moderne nous offre des matériaux artificiels manufacturés, d'un intérêt capital: tôle d'acier, tôle de bois (contreplaqué de toutes épaisseurs), tôle de ciment (fibro-ciment, etc...), tôle de liège, tôle de carton, etc..."

182 E. Menkès, "Notre programme", Chantiers, vol. 1, no. 1, January-February 1933, p. 1.

183 Menkès wrote: "Un mouvement s'esquisse depuis quelques années qui fonde ses initiatives sur un large appel à l'expérience et utilise les acquisitions de la science "utile" dans ses applications à l'industrie. Il lie étroitement l'architecture à l'état social et économique du temps présent, et consacre le principe de l'interdépendance absolue de l'art de bâtir et de l'industrie." Menkès (see note 183), p. 2. See also Menkès, "La leçon de l'industrie", Chantiers, vol. 1, no. 3, April-May 1933, pp. 1-2.

According to Joseph Abram, the early 1930s in France witnessed the development of an architectural approach -- he suggests to call *architecture technologique* -- indebted to a group of architects and builders who attempted to introduce a new conception of the Rationalist project.[184] Exemplified by the works of Paul Nelson, Oscar Nitzchké, Eugène Beaudouin and Marcel Lods, Jean Prouvé and Vladimir Bodiansky, this movement defined a "conceptual universe where technique is not a goal in itself but an 'objective' resource that helps satisfy modern demands." For Abram, the new technological architecture reinforced the expression of technique, but did not renounce aesthetic expression.

In effect, beginning in the early 1930, a number of important experiments in the industrialization of social housing changed the scale of intervention of modern architecture in France. The works of the architects Beaudoin and Lods is a case in point. In their project for the Cité du Champ des Oiseaux at Bagneux (1930-31), they combined the use of steel and reinforced concrete. It was the first complex of housing blocks executed with concrete panels made at the factory and dry assembled on a metal framework. Based on a new technique perfected by the engineer Eugène Freyssinet, the prefabricated concrete panels served to build the wall envelope.[185] This experimentation with industrialized construction was pursued in the conception of the Cité de la Muette at Drancy (1931-32).[186] The best illustration of "technological architecture", and its exploitation of modern materials and techniques, is the Maison de la Publicité conceived by Oskar Nitzchké in 1935 (fig.137).[187] Making use of a mixed construction system, the building was based on a reinforced-concrete platform supported by four mushroom-headed columns conspicuously displayed at the level of the entrance hall. The platform

[184] Joseph Abram, "Aux confins de la culture cubiste", in Pierre Chareau architecte (see note 59), p. 44.
[185] P. Peirani, "La Cité du Champ des Oiseaux", La Technique des Travaux, no. 8, August 1933, pp. 469-478.
[186] See Eugène Beaudoin, Marcel Lods, "Etude sur la rationalisation. Méthodes de construction standard dans le bâtiment", Chantiers, vol. 1, no. 2, March 1933.
[187] See Joseph Abram, "Oscar Nitzchké, la Maison de la Publicité - Paris 1935", Architecture, Mouvement, Continuité, no. 6, 1984, pp. 66-79.

itself supported a light metal skeleton that constituted the framework of the nine upper levels. Emphasizing the contrast between the solidity of the concrete columns and the lightness of the steel skeleton, Nitzchké successfully integrated the modern parameters of industrialized construction and material expression.

Conclusion

In the works of criticism and historiography of the late 1920s, most authors (Jirmounsky, Giedion, Ginsburger) presented reinforced-concrete as the primary source of French modernism. By the early 1930s however, modern architects in France had resolutely turned their attention to the recent developments of metal construction. Burying the determinist discourse of the 1920s, mosts architects keenly acknowledged that the choice of structural material depended on the program and condition of production, not on a preconceived aesthetic program. Severing the ties between structural material and external appearance, they further recognized the question of revetment materials as a specific issue.

The question of building materials was, however, exacerbated by the ideological campaign against modernism. Framing their campaign as a defence of stone against concrete, the campaigners took pains to portray reinforced concrete as an agent of international Communism, and the enemy of the traditional building industry. Yet beyond the ideological diatribe, their campaign revealed a more fundamental opposition between craftsmanship and industrialization in French architecture.

For Perret as for Le Corbusier, there was no turning back to the traditional practice of stone construction. But the solutions they proposed highlighted a radical difference in the conception of materials and processes of production. By then, Perret was paying increasing attention to the workmanship of reinforced-concrete construction. Immersed in a traditional conception of materials, Perret endeavored to turn concrete into stone, to turn the base into the noble, to turn the artificial into the natural. As such, he sought to achieve the identity of stone and concrete, thanks to their common lithic quality. Calling for the integration of traditional crafts (stone cutting, sculpture) with reinforced-concrete construction, Perret sought to humanize modern construction with the products of craftsmanship.

By contrast, Le Corbusier addressed the issue of industrialized construction and material expression in terms of the transformation of craft production -- stone sheets rather than entire stone blocks -- and the complementarity of local and industrial. Severing the value-laden distinction between natural and artificial materials, Le Corbusier sought to emphasize the contrast of their surface texture and external arrangement. In this system, natural materials were not used to perpetuate craft production, for the making of buildings was primarily conceived in terms of industrialized construction. As such, Le Corbusier's attention to the play of materials revealed a broadening of his approach to include their symbolic dimension, not a renunciation of the goals of modern industrial construction.

CONCLUSION

With the publication of Bauen in Frankreich, Bauen in Eisen, Bauen in Eisenbeton in 1928, Sigfried Giedion proposed the first synthetic interpretation of the origins and development of modern architecture in France.[1] Along with a few other works published at the end of 1920s, Giedion's book was one of the most influential in linking architectural modernism to the development of new materials and technology. Beginning with the changes brought about by industrialization and the French Revolution, Giedion focused on the dialectical relation between architects and builders, architecture and construction. He further posited construction as a French constant, insisting on the continuity between 19th-century iron buildings and 20th-century reinforced-concrete architecture. In this framework, reinforced concrete was viewed as the common denominator of French modernism. Begun with the precursory work Auguste Perret, the transformation of French architecture by means of the concrete skeleton was successfully achieved with the revolutionary works of Le Corbusier.

Though a historical study on the development of French modernism, Giedion's book was first conceived as an essay on the "new French architecture". Its primary source was a series of articles on French modern architecture published in 1926 and 1927. In April 1926, Giedion published an article on the architecture of Le Corbusier in Das Kunstblatt.[2] It was followed by a series of articles on the new French architecture published in the Zurich periodical Der Cicerone in early 1927.[3] It is during this period -- apparently between October 1926 and March 1927 -- that Giedion planned to write a

[1] Sigfried Giedion, Bauen in Frankreich - Bauen in Eisen - Bauen in Eisenbeton, Leipzig and Berlin, Klinkhardt & Biermann, 1928. [English translation: Building in France, Building in Iron, Building in Ferroconcrete, intro. by Sokratis Georgiadis, trans. by J. Duncan Berry, Santa Monica, The Getty Center for the History of Art and the Humanities, 1995].
[2] S. Giedion, "Das Neue Haus", Das Kunstblatt, vol. 10, no. 4, April 1926, pp. 153-157. [English trans: "The New House", in P. Serenyi, Le Corbusier in Perspective, Prentice-Hall, 1975, pp. 32-34].
[3] S. Giedion, "Zur Situation der fransözischen Architektur", Der Cicerone, vol. 19, January 1927, pp. 15-23; March 1927, pp. 174-189; May 1927, pp. 310-317.

book on the subject with the provisional title "Neues Bauen in Frankreich".[4] Questions regarding the real focus of the book quickly arose in discussions with the editor. In a letter to Giedion of November 1927, the editor insisted that the book bear a title stressing the "new architecture in France", "however much", as he wrote, "your real emphasis is on ferroconcrete."[5] By 1928, however, Giedion was to focus more on building materials as the key agents of modern architecture. The conference he gave in Berlin in February 1928 was entitled "Eisen. Eisenbeton. Bauen in Frankreich".[6] Though this sequence was ultimately reversed, to place emphasis on "Construction in France", the title clearly gave pride of place to materials in the definition of French modernism.

In the book, Giedion attempted to provide a historical grounding for, and an historical account of the development of the new French architecture. We know that for the preparation of the articles, Giedion met with Auguste Perret and Le Corbusier in Paris, and Tony Garnier in Lyon.[7] In writing the book, Giedion continued his research in extensive studies at the Conservatoire des Arts et Métiers in Paris, investigating 19th-century iron construction and the subsequent development of reinforced-concrete in architecture.[8] As Jean-Louis Cohen correctly underlined, the book was in fact largely indebted to the interpretation already outlined by French writers like Anatole de Baudot and Henri-Marcel Magne.[9] In his historical reconstruction of French modernism, Giedion was very much influenced by the Rationalist paradigm that permeated the French interpretive tradition.

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4 In early 1927, Giedion published an article with this same title: "Neues Bauen in Frankreich", Neue Zürcher Zeitung, 17 March 1927. For a discussion on the history of the book, see Sokratis Georgiadis, "Introduction", in Building in France (see note 1), pp. 44 ff.

5 Georgiadis (see note 5), p. 45.

6 Georgiadis (see note 5), p. 47.

7 Jean-Louis Cohen, "Sigfried Giedion, de *Bauen in Frankreich* à *Espace, temps, architecture*", unpublished conference at the S.F.A. (Paris), 8 January 1991. p. 2.

8 In his introduction to the English translation of Giedion's book, Georgiadis focuses almost exclusively on the influence of 19th-century German architectural theory, from Carl Bötticher to Karl Scheffler, and its competing conceptions of iron architecture. But he is surprisingly silent regarding Giedion's many references to French writers of the same period like César Daly and Anatole de Baudot.

9 Cohen (see note 7), p. 3.

A key influence behind the writing of Bauen in Frankreich was undoubtedly Le Corbusier.[10] In his article of 1926, Giedion had praised the architect's villa La Roche, and, in the same spirit, the book proposed an enthusiastic analysis of Le Corbusier's work, including a defence of his entry to the League of Nations competition.[11] But a close reading of the book also reveals that Giedion was not entirely indifferent to Perret's conception of modernism in its relation to the French tradition. It is true that Giedion placed Perret in the position of the precursor, giving the leading role to Le Corbusier. Yet the importance given to the transition from iron to reinforced concrete, to the idea of constructional temperament, and to the idea of a national tradition could certainly be linked to Perret's view.[12]

The influence of Perret is perhaps most noticeable in Giedion's interest in the notion of "national constant", formulated by Giedion to explain how architecture was connected with the sociological structure of each country. The "national constant" of French architecture was to be found in its "constructional temperament." The notion was also linked with the current conflict between nationalism and internationalism in modern architecture. Giedion called for the development of an international architecture, but acknowledged that each country also had a distinctive role to play in the movement.[13] The French contribution was to be its constructional temperament. Despite his insistence on this "sociological" factor, Giedion did not deny the impact of national conditions like climate, materials, and customs. For Giedion, the development of a national architecture could not be a self-conscious enterprise, yet he believed that modern architecture was also

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[10] It has often been argued that the book was written at the request of Le Corbusier. According to Jean-Louis Cohen, this argument was reiterated by Stanislaus von Moos at the Giedion symposium held at the ETH in Zurich in 1989.

[11] According to the editors of the English translation of Bauen in Frankreich, "it was the first book to exalt Le Corbusier in an unabashed way as the artistic champion of the new movement." (see note 1), p. 236.

[12] Sigfried Giedion, letter to Auguste Perret, 30 March 1927 (Fonds Perret, 535 AP 318). Giedion wrote: "Monsieur, avec grand plaisir j'ai donné l'ordre à vous envoyer aussi le second essay (sic) sur l'architecture française, qui porte, comme initiale votre portrait... Vous verrez que la jeunesse d'aujourd'hui n'oublie pas un moment les vrais initiateurs, ni la vraie tradition."

[13] Giedion wrote: "We want an international architecture. An architecture for the age. All living nations are moving toward it." Giedion (see note 1), p. 152.

influenced by "national" characteristics.[14] In an article of 1928 on the Weissenhof, Giedion was even to formulate an unexpected critique of the idea of internationalism: "There is nothing more ridiculous than to affirm that modern architecture is international. It is obvious that, for purely economical reasons, construction will be different in regions rich in iron than in a country rich in wood. The country, the climate, the customs of life impose themselves in each organic construction."[15]

Boldly constructed in terms of a continuity between the 19th and the 20th centuries, between iron and reinforced-concrete construction, between Perret and Le Corbusier, Bauen in Frankreich proposed an interpretation that emphasized the logical unfolding of French modernism. Yet with its emphasis on continuity, Giedion's historical account concealed the differences and ruptures that mark both the discourse on and the practice of the use of building materials in the development of French modernism. From the outset, Giedion ignored the critical transition from iron to reinforced-concrete construction. He also passed over in silence the pre-war debates on the problematic status of the new material and the competing conceptions of construction process that were triggered by the war and the reconstruction. Moreover, by insisting on the continuity between Perret and Le Corbusier, Giedion downplayed radical differences in their conception of the role of materials and techniques in the making of the new architecture. As such, Bauen in Frankreich contributed both to highlighting and obscuring the technical and ideological role of materials in the construction of French modernism. A brief survey of Giedion's pioneering book affords a good opportunity to assess (or to re-assess) the multifaceted role that materials played in the formation of French modernism.

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[14] Giedion wrote: "National differences develop through the influences of climate, material, and formative will, utterly independently and unconsciously." Giedion, Building in France (see note 1) p. 100.

[15] Sigfried Giedion, "La leçon de l'Exposition du "Werkbund" à Stuttgart en 1927", L'Architecture Vivante, vol. 6, no. 20, Summer 1928, p. 38: "Il n'y a rien de plus ridicule que d'affirmer éternellement que l'architecture moderne est internationale. Il est évident que, pour des raisons purement économiques, on construira différemment dans une région riche en fer que dans un pays riche en bois. La contrée, le climat et les coutumes de la vie s'imposent dans chaque construction organique."

On the transition from metal to reinforced concrete

In Bauen in Frankreich, the transition between 19th-century iron buildings and 20th-century reinforced-concrete architecture remained unexplained, leaving its specific impact on French architectural culture largely unexplored. In parallel with the technical development of reinforced concrete during the 1890s, architects quickly engaged in discussions on the architectural potential of the new material. Before any compelling use of concrete in architecture, the new material was already approached in terms of its comparison, and confrontation with iron construction. From the on, the transition from iron to reinforced concrete became a theoretical issue, with the potential development of the new material understood in terms of the failure of iron to generate a new architecture. From the outset, reinforced concrete was conceived in relation to metal construction, as "hidden metal", aesthetically, as a type of "improved" metal construction, technically.

Expurgated from theoretical discourses, metal and metal-framed construction nonetheless remained in wide use. Since metal remained the sole modern alternative to reinforced-concrete construction, its quasi-absence from the discourse on modernism indicates how long this ostracism lasted, considering that around 1928, by which time reinforced concrete had become enshrined as the material of French modernism, metal marked a decisive return to the French architectural scene. Encouraged by the incentives of French industry, metal was now primarily linked to the renewed interest in the industrialization of construction. This return of metal was soon to break the monopoly of reinforced concrete in the discourse on French modernism. As such, Bauen in Frankreich -- in which concrete appears to naturally supersede iron construction -- was published at the very moment modern architects in France began to adopt a more relativist position regarding building materials.[16]

[16] Framing this question in terms of the succession of building materials, Giedion writes in the conclusion of the book: "Just as the nineteenth century -- at a given moment -- developed iron and ferroconcrete for its needs, so we can assume that our age, too, will find the material that responds to its demands." Giedion (see note 1), p. 204.

On the changing definition of reinforced-concrete as a building material

In Bauen in Frankreich, Giedion views reinforced concrete as a well-defined entity in the physical and terminological sense, insisting on the stability of the material conceived as a laboratory product and implemented by means of scientific, industrialized building production. As we have seen, this assumed stability was not well reflected in the changing definition of the material within French architectural theory. Emphasizing the heterogeneous nature of the material, the first interpreters of the new system did not hesitate to subsume it under the category of iron construction. In the following decade, interest in the metal armature was gradually displaced in favor of a concern for the surface of the material, which provided an alternate definition of the "architectural" nature of concrete. Minimizing the internal duality of the composite material, architects shifted attention to the (mono)lithic quality of reinforced concrete. In an attempt to upgrade its status, reinforced-concrete construction came to be conceived in terms of its complementarity with modern ceramics, both of which were viewed as new industrial materials. But the making of concrete was still relegated to the building site and its contingencies. It is only during the war and the reconstruction that reinforced concrete, now understood in terms of a radical opposition between natural and artificial materials, came to be approached in terms of laboratory production and industrialized construction.

Yet despite allusions to the laboratory and the world of industry, the actual use of reinforced concrete during the 1920s was most often conceived in terms of its complementarity with masonry work. By that time, cut stone had been virtually replaced by brick or the cement block, and stone dressing by the technique of cement bonding. This assimilation to masonry was effected along two divergent paths. For modern architects like André Lurçat and Robert Mallet-Stevens, reinforced concrete was used as a complement to brick, cement, or cinder-block construction. A consequence of architectural programs as well as of the state of the building industry, this use of reinforced concrete within mixt structural systems encouraged the treatment of the material as a masonry component.

Perret's conception of reinforced-concrete construction also alluded to the masonry tradition, but here concrete came to be conceived as a kind of modern stone. Probably inspired by the "unity of materials" achieved during the French Middle Ages, Perret advocated the development of an architecture entirely made of concrete, the *architecture du béton armé*. Perret's masonry model was embodied in buildings where both the skeleton and the infill were to be made of concrete, and where the infill would take the configuration of a modern *appareil* [stone dressing]. In direct response to the competing program of industrialized materials and production, Perret was engaged in the naturalization and nationalization of reinforced-concrete construction.

On the structural skeleton

For Giedion, the constructional function of both metal and reinforced concrete was understood in terms of the structural skeleton. Works of iron architecture examined in the book were all constituted of a metal skeleton. The development of reinforced-concrete architecture was also conceived in terms of skeleton construction. Contrasting Robert Van't Hoff's concrete house of 1915 with Le Corbusier's Dom-ino house of the same year, Giedion insisted on the latter's bold conception of skeleton construction.[17] For Giedion, the revolution brought about by new materials was primarily a transformation triggered by the structural skeleton.

During the 1920s, modernist discourses opposed skeleton construction to the tradition of load-bearing walls. This opposition was most often theoretical, however, for as we have seen, architects often merged the skeleton within traditional masonry construction. Full-fledged, autonomous concrete skeletons were seldom used, in preference to a mixed structural system that combined reinforced-concrete elements with

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[17] Giedion (see note 1), p. 168.

load-bearing masonry construction. More important, major differences are revealed in the conception and role of the concrete frame itself. While Le Corbusier conceived the modern house with the frame in mind, Mallet-Stevens approached the frame as a secondary system to be inserted within a masonry type structure. These differences are not solely technical, for they provide clues as to the conceptual process followed and the sources of the aesthetic project itself. With Lurçat and Mallet-Stevens, the tectonic potential of the concrete frame developed out of the masonry tradition. With Le Corbusier, the frame was exploited to subvert the visual conventions of masonry architecture.

The two most articulate advocates of skeleton construction were Perret and Le Corbusier. Both placed the skeleton at the source of the new architecture. The difference between the two lay in the function assigned to the skeleton in the aesthetic system. For Perret, the role played by the skeleton was to be visually expressed in the building facade. For Le Corbusier, the role played by the skeleton was to be manifested in the logic of the form itself: standardized dimensions, elevation from the ground, separation of wall and envelope. For Perret, the frame provided both the basic structural support and ornament for the building. For Le Corbusier, it acted as the generative structure of the building. For Perret, the frame was necessarily to be in reinforced concrete. For Le Corbusier, the adoption of reinforced concrete proved to be a choice based on cultural and economic conditions. With the *Five Points*, the principle of the skeleton took precedence over the material itself, encouraging a shift to the use of a metal frame and the realization of the *maison à sec.*

On the treatment of the concrete surfaces

Focusing on the structural function of new materials, Giedion paid little attention to the issue of external appearance. Yet from the moment concrete was employed in works of architecture, the question of the material's external treatment occupied central stage.

During the last decade of the 19th century, De Baudot and the Rationalists favored the use of inlaid decoration incrusted in the surface of the bare cement. Reproducing a practice common in Byzantine architecture, the Rationalists chose to increase the visual appeal of the cement itself. Inlaid decoration was soon to be challenged by the practice of cladding. Based on the use of small ceramic materials, this practice -- probably inspired by the Viennese school and the works of Otto Wagner -- sought to cover concrete with a decorative skin.

While he first opted for the use of ceramic materials, as in the 25bis rue Franklin, Perret was later to adopt a technique based on large slab revetments. For Perret as for Loos, the quality of the revetment was key in determining the status of a building. At the Champs-Elysées theater, Perret used marble veneer to fashion a monumental mask. On the eve of the First World War, Perret had successfully integrated the use of reinforced-concrete construction within an architectural aesthetic that replaced traditional ornamentation by revetment materials.

Before the 1920s, the use of rough-cast concrete -- a recurrent theme of modernist historiography -- was not an architectural issue. It is only during the second half of the 1920s, with Perret's critique of modernist architecture, that the treatment of bare concrete became a doctrinal issue. Rejecting the use of coating, Perret denounced the concealment of the structural material in modernist architecture. He called for the "truthful" use of materials in architecture, recalling the turn-of-the-century Rationalist demand for material and structural "sincerity". By then, Perret's concrete was carefully crafted both in its internal composition and its external treatment, evoking the surfaces of masonry work. In the late 1920s, Perret's call for "truth to material" was based on a conception of concrete that sought to affirm its lithic quality.

By the early 1930s, however, coating was gradually abandoned in favor of revetment materials that were either natural or artificial: thin stone slabs or thin industrialized concrete slabs. But while Perret encouraged the use of materials that stressed their function as infill, Le Corbusier made sure that the material envelope was perceived as a thin protective revetment. For Le Corbusier, the revetment material was not conceived as a mode of concealment but as a layer constitutive of the modern wall. His attention to building revetments developed in parallel with his increasing interest in natural materials and their contrast with industrial materials (rough stone and polished stone slab). Recognizing the sensuous as well as symbolic value of materials, Le Corbusier advanced a modernist aesthetic that advocated the appreciation of materials -- both natural and industrial -- for their visual, physical, and sensuous quality.

Craft production versus industrialized construction

During the war and reconstruction period, architects framed the issue in terms of the opposition between natural and artificial materials. For both Perret and Le Corbusier, reinforced concrete was placed on the side of artificial material. But this temporary consensus concealed major differences. From the time of the reconstruction onward, Perret increasingly focused on the role of the formwork in the making of reinforced concrete structures. For Perret, the reuse of formworks was key to the economy of concrete construction. Developed in the filed of industrial buildings, Perret's practice of reusable formorks was rapidly transferred to the domain of public architecture, a transfer exemplified by the experience of the Raincy church. Yet in all of these projects, Perret made use of reusable formworks for the making of unique objects.

In fact, Perret's conception of the role of the formwork in concrete construction was not merely technical, but profoundly architectural. Conceived as a mold that fashioned the "liquid material", the formwork was key to the expression of the concrete material. It is first by means of the formwork that Perret attempted to highlight the lithic quality of concrete, as in the case of the Raincy church. During the 1920s, Perret refined his technique -- combining the careful crafting of the the mold, choice of aggregates, and treatment of the resulting surfaces -- to emphasized the aesthetic quality of bare concrete.

As such, Perret's work echoed the contemporary vision of reinforced concrete as *l'appareil de l'architecture moderne*, a pre-industrial conception that saw the material as a means by which to achieve the synthesis of structure, mode of assembly, and external appearance. During the 1930s, Perret sought to achieve this ideal synthesis with the conception of the Musée des Travaux publics in Paris (1936-48), a monument that was to be entirely and exclusively made of concrete. Presented as the true *architecture du béton armé*, Perret's work attempted to bridge the modernization of construction and French architectural tradition, a project that led to the re-conception of reinforced concrete as modern stone. As such, Perret conceived of reinforced concrete construction as a practice grounded in the tradition of building craftsmanship, as a practice that ultimately resisted the call for the industrialization of construction.

By contrast, Le Corbusier posited the industrialization of construction as key to the development of the new architecture. Beginning with the Dom-ino project in 1914, Le Corbusier envisioned reinforced concrete construction in terms of industrialized and standardized structural elements. First conceived as an industrial product, reinforced concrete was integrated within a larger approach to construction that paid little attention to the appearance and status of building materials. But the industrialization of concrete construction proved difficult to implement. Rooted in the practice of masonry construction, a practice that required work on the building site, reinforced concrete construction did not lent itself to the constraints of industrialization. From Pessac to Weissenhof, Le Corbusier's practice gradually shifted from industrialization of the concrete frame to industrialization of building elements (like window frames). This shift also marked a change in Le Corbusier's interest from concrete to steel construction. Giving precedence to the process over the material itself, Le Corbusier was adament in his conception of modern architecture in terms of industrialized construction.

The opposition between craft production and industrialized construction was most clearly expressed in the context of the ideological debate on modernism that unfolded in the early 1930s. Triggered on the basis of the ideological opposition between stone and concrete, this debate revealed the distance between Perret's and Le Corbusier's conceptions of modern construction. Calling for the need to keep alive traditional craftsmanship, Perret encouraged the superimposition of decorative works (like low reliefs) to buildings in reinforced concrete. By contrast, Le Corbusier stressed the need to adapt the skills of traditional building trades to the new logic of industrialized construction.

Nationalism versus Internationalism

Beginning with the ideological reassessment of French Gothic architecture in the early nineteenth century, the question of building materials in French architecture had come to be discussed in terms of the national tradition. Discussions on modern materials were not to escape this interpretive framework. The debate on the nationality of reinforced concrete was to reflect the contemporary tensions within French architectural and artistic culture. Until the turn of the century, discussions on the national status of the new material proved secondary to the task of defining its potential impact on architecture. Yet by the early 1910s, with the critical reception of the Champs-Elysées theater, reinforced concrete construction came to be associated with foreign, not to say Germanic influences. In the theater project, the modern status of the material was to be easily amalgamated with the troubling novelty of the facade. In the early 1920s, however, the construction of the Raincy church enabled Perret to confirm his attachment to the French tradition. From then on, Perret and his circle sought to demonstrate the Frenchness of reinforced concrete construction. While in his theory, Perret did not hesitate to define concrete as modern stone, in his work, he even experimented with the possibilities to give concrete the color, texture, and appearance of local stones.

Perret's ideological campaign to define reinforced concrete as a French material contrasted, and confronted the internationalist stance defended by the more radical architects of the French modern movement. Though modernist architects considered reinforced concrete as a key played in the modernization of construction in France, the material was praised precisely for its universal, international character. In the early 1920, both Perret's and Le Corbusier's insistence on the preeminence of the concrete frame endowed the material with a broad international mission. But Perret's emphasis on the transformation of the material's appearance clashed with Le Corbusier's emphasis on the industrialization of construction, and the corollary treatment of building materials as industrial products. The early 1930s campaign against modern architecture, a campaign launched on the basis of the economic and ideological opposition between concrete and stone, further highlighted the nationalism surrounding the question of materials in French architecture. At stake for both Perret and Le Corbusier was not so much the employment of concrete -- the material was there to stay -- but its reconciliation with traditional building materials and techniques. Their response was radically opposite. Perret sought to further assimilate concrete with stone, to achieve the identity of concrete and stone, in an attempt to enshrine concrete within the national tradition. Le Corbusier sought to turn stone into an industrial material, to integrate it within the logic of modern industrialized construction, a logic that unfolded beyond national borders.

On the 'rhetoric of materials' in French modern architecture

Beginning with the mid-nineteenth century debate on the function and visibility of modern materials in architecture, discourses on building materials played a key role in the definition of modern architecture in France. Central to these discourses was a set of belief on the necessary relationship between form, structure, and ornament that came to be known as Rationalism. Rationalist rhetoric pervaded both the practice and the interpretation of French modernism. Accordingly, the development of reinforced concrete in French architecture was broadly theorized in terms of Rationalist tenets.

Contrasting with the tenets of French rationalism -- with its emphasis on the "visibility" of structure and materials -- Germanic architectural theories of the nineteenth century focused on the dual nature of the architectural construct . Grounding his analysis on the distinction made by Karl Bötticher between core-form (*Kernform*) and art-form (*Körperform*), and the thesis of "dressing" (*Bekleidung*) formulated by Gottfried Semper, Werner Oechslin suggests to study modern architecture in light of the distinction between the stylistic husk and the kernel of building.[18] For Oechslin, the development of modern architecture is thus to be understood (metaphorically) as a process in which the stylistic husk is gradually stripped away (in theory) to reveal the new, Modernist kernel.[19] The stripping away of the nineteenth-century stylistic husk to reveal the modernist kernel is a process that recalls Giedion's interpretation of the role of construction described in Bauen in Frankreich.[20] This analogy might help characterize the transformations that marked the development of reinforced concrete in French modern architecture.

Because of his insistence on the role of the concrete frame in the genesis of his work, Perret always appears to have focused on the "kernel" as the basis of modern architecture. But, as our study shows, Perret's work also reveals his gradual attempt to turn the kernel into a stylistic husk. In effect, from the reinforced concrete frame represented on the facade of the 25bis rue Franklin to the reinforced-concrete frame embodied in the colonnade of the Musée des Travaux publics, Perret's work appears as a continuous search for turning the constructional kernel into a stylistic husk.

The constructional kernel was also at the basis of Le Corbusier's conception of architecture. But contrary to Perret's, Le Corbusier's theory and work start from the kernel to rethink the status of the husk, in an attempt to transform the nature of both.

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[18] Werner Oechslin, Stilhülse und Kern: Otto Wagner, Adolf Loos und der evolutionäre Weg zu modernen Architektur, Zurich, gta/Ernst & Sohn, 1994.

[19] Harry Francis Mallgrave, Review of "Stilhülse und Kern", in JSAH, vol. 55, no. 2, June 1996, p. 194.

[20] Giedion wrote: "Construction in the nineteenth century plays the role of the subconscious. Outwardly, construction still boasts the old pathos; underneath, concealed behind facades, the basis of our present existence is taking shape." Giedion (see note 1), p. 87.

Taking the frame as the basic generative structure of the building, Le Corbusier came to conceive the house as a system that merged the constructional with the formal. Synthesized in the *Five Points*, this system led the way to overcoming the conventions of structural rationalism. Viewed in this way, Le Corbusier's interest in revetment materials in the late 1920s is not merely a return to the stylistic husk. Rather, challenging the separation between constructional kernel and stylistic husk, Le Corbusier linked the conception of external revetments to the logic of the construction process itself, in an attempt to treat the revetment as a constituent part of the Modernist kernel. In the early 1930s, Le Corbusier began to play on the contrast between natural and artificial, traditional and industrial materials, developing a new 'language' of materials that further undermined the conceptual separation between constructional kernel and ornamental husk (Was the rough-stone masonry wall of the Swiss pavilion's ancillary block structural or ornamental ?).

The diverging conceptions of kernel and husk in the works of Perret and Le Corbusier help reveal the distinct trajectory of their architectural project. They also highlight the 'rhetoric of materials' that inflected the whole debate on, and practice of modern architecture in France. The notion of rhetoric is conventionally understood as a mode of speaking designed to persuade or impress. Yet in its first acceptation it is also a notion that, referring to the art of language, implies the mastery of the technique of expression. Ultimately, the discourse on materials in French architecture was to partake of both practices. For if it was to serve in the framing and interpretation of modern architecture, it was also to play a key role in giving French modern architecture its distinctive 'materiality'.

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BIBLIOGRAPHY

PRIMARY SOURCES

BESNARD, Charles-Henri. Archive. Centre d'archives d'architecture du XXe siècle, Institut Français d'Architecture (IFA), Paris.

GUADET, Paul. Archive. Centre d'archives d'architecture du XXe siècle, Institut Français d'Architecture (IFA), Paris.

HENNEBIQUE, François. Archive. Centre d'archives d'architecture du XXe siècle, Institut Français d'Architecture (IFA), Paris.

LE CORBUSIER. Archive. Fondation Le Corbusier (FLC), Paris.

LURÇAT, André. Archive. Centre d'archives d'architecture du XXe siècle, Institut Français d'Architecture (IFA), Paris.

PERRET, Auguste. Archive. Centre d'archives d'architecture du XXe siècle, Institut Français d'Architecture (IFA), Paris.

RICHARD, Joachim. Archive. Centre d'archives d'architecture du XXe siècle, Institut Français d'Architecture (IFA), Paris.

Institut National de la Propriété Industrielle (I.N.P.I.), Paris.

Conservatoire National des Arts et Métiers (C.N.A.M.), Paris.

PRINTED SOURCES[1]

PRE-1915

A. D. "Maison de rapport, avenue Perrichont." Le Béton Armé vol.11, no.121 (June 1908), 67-73.

ANONYMOUS. "L'architecture et le ciment armé. Brochure de A. de Baudot." La Construction Moderne vol.21, no.9 (2 December 1905), 103.

ANONYMOUS. "Conférence de M. Cottancin sur les travaux en ciment armé avec ossature métallique." Bulletin de l'Union Syndicale des Architectes Français vol.3, nos.8/9 (August-September 1895), 169-225.

ANONYMOUS. "Conférence de M. Flament à la Société centrale d'Architecture de Belgique." Le Béton Armé vol.4, no.44 (January 1902), 97 ff.

[1] Note: not all articles found in architectural archives are listed in bibliography, see footnotes for sources. Square brackets around author name indicates that authorship may be unclear, or indicate editorial, principal author, organizer of conference, etc. In many cases the term "Anonymous" has been used.

ANONYMOUS. "Conférence de M. Paul Gout sur le concours ouvert entre les architectes français pour l'exposition universelle de 1900." Bulletin de l'Union Syndicale des Architectes Français vol.3, no.1 (January 1895), 5-17.

ANONYMOUS. "Congrès des Architectes Français de 1896." L'Architecture no.21 (23 May 1896), 178; no.43 (24 October 1896), 321-322.

ANONYMOUS. "L'inauguration du Théâtre des Champs-Elysées." L'Illustration vol.71, no.3658 (5 April 1913), 302.

ANONYMOUS. "Maison de Rapport rue Danton à Paris." Le Béton Armé vol.3, no.36 (May 1901), 1.

ANONYMOUS. "La maison du peuple à Belleville." La Construction Moderne vol.22 (8 June 1907), 425-428.

ANONYMOUS. "Maison rue Claude Chahu, à Paris." La Construction Moderne vol.8 (1902-03), 365-366.

ANONYMOUS. "Rapport sur les grès flammés de MM. Bigot et Cie." Bulletin de l'Union Syndicale des Architectes Français no.21 (September 1900), 621-629.

ANONYMOUS. "Les trahisons du fer." Le Béton Armé vol.4, no.47 (April 1902), 156; no.48 (May 1902), 175.

ANONYMOUS. "Science et empirisme." Le Béton Armé vol.5, no.51 (August 1902), 45.

ANONYMOUS. "Troisième congrès du Béton de Ciment Armé." Le Béton Armé vol.2, no.9 (February 1899).

ARNAUD, E. "Réponse de M. Arnaud." Le Béton Armé vol.3, no.36 (May 1901).

AUGUSTIN-REY, Adolphe. "Les constructions en acier et eiment armé." International Congress of Architects: Seventh session held in London 16-21 July 1906. London, 1908, 188-204.

BIGOT, Alexandre. Les Grès de Bigot. 2nd edition. Paris, 1902.

BOILEAU, Louis-Auguste. Débat sur l'application du métal à la construction. Paris, 1855.

BOILEAU, Louis-Auguste. Le Fer, principal élément constitutif de la nouvelle architecture. Paris, 1871.

BOILEAU, Louis-Auguste. Histoire critique de l'invention en architecture. Paris, 1886.

BOILEAU, Louis-Auguste. Nouvelle forme architecturale. Paris, 1853.

BOILEAU, Louis-Auguste. Les Préludes de l'architecture du XXe siècle et l'Exposition du centenaire. Paris, 1893.

BOILEAU, Louis-Auguste. Principes et exemples d'architecture ferronnière. Paris, 1881.

BOILEAU, Louis-Charles. "L'Art et le Fer." L'Architecture vol.2 (1889), 110-115, 171-173, 181-183, 207-211, 242-244, 256-257, 373-377, 496-501, 517-523.

BOILEAU, Louis-Charles. "L'Art Nouveau." L'Architecture vol.13, no.51 (22 December 1900), 466.

BOILEAU, Louis-Charles. "Causerie." L'Architecture vol.13, no.48 (1 December 1900), 431; vol.14, no.32 (22 August 1903), 312; vol.16, no.34 (22 August 1903), 332; vol.16, no.32 (8 August 1903), 313.

BOILEAU, Louis-Charles. "Le ciment armé et l'art de l'architecture." L'Architecture vol.18, no.49 (9 December 1905), 455; no.51 (23 December 1905), 471-473.

BOILEAU, Louis-Charles. "Le ciment armé: nouvelles méthodes d'application." L'Architecture vol.8, nos.44, 45, 46, 47, 49, (November-December 1895).

BOILEAU, Louis-Charles. "Constructions en céramique. Le Pavillon de la Manufacture de Sèvres à l'Exposition de 1900." L'Architecture vol.16, no.51 (19 December 1903), 482.

BOILEAU, Louis-Charles. "Le nouveau matériau." L'Architecture vol.18, no.48 (2 December 1905), 442-443.

BOILEAU, Louis-Charles. "Un projet de terrasse en ciment armé." L'Architecture vol.19, no.2 (13 January 1906), 12-14.

BOILEAU, Louis-Charles. "Le rationalisme gothique et la raison classique." L'Architecture vol.2, no.50 (1889); vol.3, nos.2, 6, 10 (1890).

BOILEAU, Louis-Charles. "Réponse à M. Gout." L'Architecture vol.2, no.51 (1889), 608.

BOILEAU, Louis-Charles. "Les travaux en ciment armé." L'Architecture vol.9, no.40 (3 October 1896), 299-300.

BOILEAU, Louis-Charles, and Eugène Emmanuel VIOLLET-LE-DUC. "St-Eugène and the Gothic debate. Boileau and Viollet-le-Duc." In Eugène Emmanuel Viollet-le-Duc 1814-1879, 54-59. London: Architectural Design Profile, 1978.

BRAIVE, Jean. Aide-mémoire de l'ingénieur-constructeur de béton armé. Paris: H. Dunod et E. Pinat, 1914. 2nd revised edition, 1919.

BRINCOURT, Maurice. "Le nouveau théâtre des Champs-Elysées." L'Architecture vol.26, no.20 (17 May 1913).

CHABAT, Pierre. La brique et la terre cuite. Paris: A. Morel, 1881.

CHAINE, Emile. "Dispositions générales relatives aux halles aux poissons." Le Béton Armé vol.12, no.136 (September 1909), 137-138.

CHAINE, Henri. "Communication de M. Chaine sur le ciment armé au Congrès des Intérêts généraux du Bâtiment de 1910." Le Rationaliste 5th ser., no.58 (June 1914).

CHAINE, Henri. "Exposition universelle de 1889." Encyclopédie d'Architecture 4th ser. vol.2 (1889-1890).

[CHAINE, Henri] "L'Église St-Jean-de-Montmartre. Conférence de M. H. Chaine." La Construction Pratique no.21 (1 April 1905); no.22 (1 May 1905); no.24 (1 July 1905); no.25 (1 August 1905).

CHAINE, Henri. "A propos de la méthode de composition en Architecture." Encyclopédie d'Architecture 4th ser., vol.3 (1890-91), 116-119.

CHAMPURY, Edouard."Exposition Universelle de 1889 - La crise de l'architecture et l'avènement du fer." L'Art vol.15, no.47 (1889).

CHAUMELIN, Gaston. L'avènement de l'âge du fer dans l'architecture. Le Mans: Edmond Monnoyer, 1889.

CHOISY, Auguste. L'Art de bâtir chez les Romains. Paris, 1873.

CHOISY, Auguste. Histoire de l'architecture. 2 vols. Paris: Gauthier-Villars, 1899. Reprint, Paris: Inter-Livres, 1991.

CHRISTOPHE, Paul. Le béton armé et ses applications. Bruxelles: J. Goemaere, 1899. 2nd edition. Paris: Ch. Béranger, 1902.

CLOQUET, Louis. Traité d'architecture. 5 vols. Paris-Liège: Béranger, 1898-1901.

COIGNET, Edmond, and Napoléon DE TEDESCO. "Du calcul des ouvrages en ciment avec ossature métallique." Bulletin de la Société des Ingénieurs Civils de France (16 March 1894), 282-363.

Congrès International des Architectes: Sixième session tenue à Madrid du 6 au 13 avril 1904. Madrid, 1906.

CONZELMAN, J.-E. "Les progrès de la construction en ciment armé par voûte." Le Ciment Armé (April 1913), 61-74.

COTTANCIN, Paul. "Conférence de M. Cottancin sur les travaux en ciment avec ossature métallique." Bulletin de l'Union Syndicale des Architectes Français vol.3, nos.8/9 (August-September 1895).

COTTANCIN, Paul. "A propos de L'Eglise St-Jean-de Montmartre." La Construction Pratique no.25 (1 August 1905), 52-53.

COTTANCIN, Paul. "Travaux en ciment avec ossatures métalliques." Procès verbaux des séances de la Société des Ingénieurs Civils de France (15 February 1889), 90.

COUTURAND, Paul. "Les méthodes américaines. Principes de la direction d'un bureau d'architecte." La Construction Moderne (18 May 1913), 392-394; (1 June 1913), 416-417.

COUTURAND, Paul. "Le système de Taylor." La Construction Moderne (27 April 1913), 356-358; (4 May 1913), 368-369.

CROISILLES, Marc. "Maisons d'aujourd'hui et de demain." La Construction Pratique no.27 (1 October 1905), 431-435.

DE BAUDOT, Anatole. "L'architecture à l'exposition universelle de 1889." Encyclopédie d'Architecture 4th ser., vol.2 (1889-90), 17-18, 25-26, 51-53.

DE BAUDOT, Anatole. L'architecture et le ciment armé. Paris: Office général d'Editions artistiques, n.d. [c. August 1905].

DE BAUDOT, Anatole. L'architecture, le passé, le présent. Paris: Henri Laurens, 1916.

DE BAUDOT, Anatole. "Conférence de M. de Baudot sur L'application à l'architecture moderne de nouveaux systèmes et procédés de construction, particulièrement sur l'emploi du ciment et du fer pour la structure des planchers et des combles." Bulletin de l'Union Syndicale des Architectes Français vol.2, no.2 (February 1893), 31-37.

DE BAUDOT, Anatole. "Visite du Lycée Victor-Hugo." Bulletin de l'Union Syndicale des Architectes Français, vol.2, no.19 (July 1894), 318-325.

DE LAPPARENT, Albert. Le Siècle du Fer. Paris: Librairie F. Savy, 1890.

DE LA SIZERANNE, Robert. "L'Art à l'Exposition 1900 - L'esthétique du fer." Revue des Deux-Mondes vol.159 (1 May 1900), 175-206.

DE LA SIZERANNE, Robert. "La religion de la beauté - Etudes sur John Ruskin. Sa physionomie." Revue des Deux-Mondes (1 December 1895); "Sa pensée." (1 February 1897); "Sa pensée sur l'art." (1 March 1897); "Sa pensée sur la vie." (15 April 1897); "Ses paroles." (1 June 1896).

DENFER, J. Maçonnerie (Encyclopédie des Travaux Publics). Paris: Librairie Baudry, 1891.

DE THUBERT, Emmanuel. "Le Théâtre des Champs-Elysées." L'Art de France vol.1, no.1 (15 June 1913).

DE VILLENOISY, François. "L'architecture en fer et l'Ecole française contemporaine." Revue des Arts Décoratifs vol.16 (1895-96), 7-15, 277-286, 325-333.

DE VOGUE. "La défunte exposition." Revue des Deux-Mondes vol.162 (15 November 1900).

DUCHAMP-VILLON, Raymond. "L'architecture et le fer." Poème et Drame no.7 (January-March 1914), 22-29.

DUPUIS, Eugène. "La raison, la logique, le beau, l'art." L'Architecture vol.18, no.33 (19 August 1905), 315.

DUPUIS, Eugène. "Revue [L'architecture et le ciment armé]." L'Architecture vol.18, no.37 (16 September 1905), 351-52.

EDISON, Thomas. "Le béton coulé." La Construction Moderne (19 April 1914).

EDISON, Thomas. "Le bois et le ciment armé en Amérique." La Construction Moderne (29 July 1911), 520.

EDISON, Thomas. "La maison moulée d'Edison." L'Architecture vol.23, no.11 (12 March 1910), 97.

FAYOLLE, A., ed. Le Ciment. Paris, 1896-1936.

FORTHUNY, Pascal. "Bétons et ciments historiques." Le Béton Armé vol.4, no.38 (July 1901), 22-24; vol.4, no.41 (October 1901), 63-69.

FORTHUNY, Pascal. "Le ciment armé rue Danton." Le Béton Armé vol.3, no.36 (May 1901).

FORTHUNY, Pascal. "Dix années d'architecture." Gazette des Beaux-Arts (February 1910), 191-210; (May 1910), 426-440.

FORTHUNY, Pascal. "Les hontes de l'architecture. Architecture ? Pourritures !" Les Cahiers de l'Art Moderne no.2 (1913).

FORTHUNY, Pascal. "Mortiers et bétons romains." Le Béton Armé vol.4, no.43 (December 1901), 93.

FORTHUNY, Pascal. "Le Théâtre des Champs-Elysées." Les Cahiers de l'Art Moderne no.7 (30 October 1913), 6-14.

GALLOTTI, Paul. "Le béton armé en architecture." Le Béton Armé vol.11, no.127 (December 1908), 163-165.

GALLOTTI, Paul. "Le béton de ciment armé, avantages et inconvénients." Le Béton Armé vol.10, no.112 (September 1907), 136.

GALLOTTI, Paul. "1892-1902. Dix ans de Béton Armé." Le Béton Armé vol.5, no.55 (December 1902), 112-113.

GALLOTTI, Paul. "Maison de Rapport, rue Danton, n. 1, à Paris." Le Béton Armé vol.4, no.41 (October 1901), p.58.

GALLOTTI, Paul. "Propriété de M. Danois." Le Béton Armé vol.11, no.127 (December 1908), 163-165.

GARNIER, Charles. A travers les arts. Paris, 1869.

GELBERT, A. "Conférence sur l'architecture au XXe siècle et l'Art Nouveau, par M. Paul Gout, architecte." La Construction Moderne vol.19 (19 December 1903), 136-138; vol.19 (26 December 1903), 148-149; vol.20 (2 January 1904), 158-159.

GELBERT, A. "Cours du Trocadéro. Conférence de M. de Baudot." La Construction Moderne vol.19, no.10 (5 December 1903), 111-113.

GELLUSSEAU, Louis. "Constructions civiles: le théâtre des Champs-Elysées à Paris." Le Génie Civil vol.33, no.1608 (5 April 1913).

GOUT, Paul. "Coup d'oeil rationaliste sur l'exposition universelle." Encyclopédie d'Architecture 4th ser., vol. 2 (1889-90).

GOUT, Paul. "Le Rationalisme vis-à-vis de ce que les classiques appellent 'leur raison'." Encyclopédie d'Architecture 4th ser., vol.2 (1889-90), 85-88.

GOUT, Paul. "Réponse à M. Boileau." Encyclopédie d'Architecture, 4th ser., vol.2 (1889-90), 65-67.

GRASSET, Eugène. La plante et ses applications ornementales. Paris: Lévy, 1896.

GUADET, Julien. Eléments et théorie de l'Architecture. 4 vols. Paris: Librairie de la Construction moderne, 1901-04.

GUADET, Paul. "Le Théâtre des Champs-Elysées." L'Architecte vol.8 (October 1913), 73-80; (November 1913), 81-87.

GUADET, Paul. "L'oeuvre du professeur Otto Wagner." L'Architecte vol.1 (15 December 1906), 89-93.

HAMLIN, A.D.F. "L'Architecture extérieure des édifices hauts aux États-Unis d'Amériques." In Congrès International des Architectes: Cinquième session tenue à Paris du 29 juillet au 4 août 1900. Paris, 1906.

HENARD, Eugène. "Exposition universelle de 1889. Le Palais des Machines; IX. Emploi décoratif du fer." L'Architecture vol.2, no.33 (1889), 387-394.

HUYSMAN, Joris-Karl. "Le fer" Certains. Paris, 1890. Reprint, L'Art Moderne/Certains, Paris, Union Générale d'Editions, 1975.

HUYSMAN, Joris-Karl. "Le salon officiel de 1881." L'Art Moderne. Paris,1883. Reprint, L'Art Moderne/Certains, Paris, Union Générale d'Editions, 1975.

JAMOT, Paul. "Le Théâtre des Champs-Elysées." Gazette des Beaux-Arts vol.55, no.669 (April 1913), 261-294.

JEANNERET, Charles-Edouard. Etude sur le mouvement d'art décoratif en Allemagne. La Chaux-de-Fonds: Haefeli et Cie., 1912.

JEANNERET, Charles-Edouard. "Le renouveau de l'architecture." L'Oeuvre no.2 (1914).

JOURDAIN, Frantz. "L'Architecture à l'Exposition Universelle." La Construction Moderne vol.4 (1888-89), 469-70.

JOURDAIN, Frantz. "La céramique et l'architecture." Bulletin de l'Union Syndicale des Architectes Français no.20 (August 1898), 688-692.

JOURDAIN, Frantz, et al. "Les conquêtes de la science - L'Architecture." L'Architecture vol.13, no.42 (20 October 1900); vol.13, no.43 (27 Octobre 1900); vol.13, no.44 (3 November 1900); vol.13, no.47 (24 November 1900).

JOURDAIN, Frantz. "La décoration et le rationalisme architectural à l'Exposition Universelle." Revue des Arts Décoratifs vol.10 (1889), 33-38.

JOURDAIN, Frantz. "Que pensez vous de l'architecture moderne?" L'Architecture vol.8, nos.40-52 (5 October 1895 - 28 December 1895).

JOURDAIN, Frantz. "Que pensez vous de l'architecture moderne?" Revue des Arts Décoratifs vol.16 (1896), 93-96.

KAHN, Gustave. Esthétique de la rue. Paris: Bibliothèque Charpentier, 1901.

LAHOR, Jean. Les Habitations à Bon Marché et l'Art Nouveau pour le Peuple. n.d. [1903].

LOOS, Adolf. "Ornement et crime." Cahiers d'Aujourd'hui vol.2 (1912).

LOUVET, Albert. L'art d'architecture et la profession d'architecte. 1911.

MAGNE, Lucien. L'architecture française du siècle. Paris: Firmin-Didot, 1889.

MAGNE, Lucien. "L'architecture moderne." Art et Décoration vol.3 (January-June 1898), 45-53, 73-80.

MAGNE, Lucien. "L'art appliqué aux métiers. Application de l'art au travail des métaux." Revue des Arts Décoratifs vol.22 (1902).

MAGNE, Lucien. "La décoration du fer." L'Art décoratif vol.5 (1900), 122-133.

MAGNE, Lucien. "Le fer dans l'art moderne." Revue des Arts Décoratifs vol.20 (1900), 351-358, 378-382.

MAGNE, Lucien. "Résumé du cours de M. Magne. Applications de l'art au travail des métaux." Revue des Arts Décoratifs vol.22 (1902), 33-48.

MALLET-STEVENS, Robert, and Jacques ROEDERER. "Notes from Paris." The Architectural Review vol.23 (January-June 1908), 257.

MARX, Roger. "L'Art social et l'Exposition de Bruxelles." Gazette des Beaux-Arts vol.4 (June 1910).

MATRAI. Le Fer-Béton no.1 (1899).

MEYER, Alfred Gotthold. Eisenbauten, ihre Geschichte und Aesthetik. Esslingen: Paul Neff Verlag, 1907.

MONOD, E. L'Exposition Universelle de 1889. vol.1. Paris: Dentu, 1890, xxvi-xxvii.

OLIVE, Gustave. "Ecuries et manutentions des magasins du Bon Marché à Paris." L'Architecture vol.11, no.16 (16 April 1898), 139.

PICARD, Alfred. Exposition Universelle Internationale de 1900 à Paris: Rapport général administratif et technique. 9 vols. Paris: Imprimerie nationale, 1902-03.

PLANAT, Paul. "Actualités." La Construction Moderne vol.15, no.28 (14 April 1900), 327; no.35 (2 June 1900), 410.

PLANAT, Paul. "Actualités. Le VIe Congrès International." La Construction Moderne vol.19 (16 April 1904), 337-339; (30 April 1904), 364-365; (11 June 1904), 440-441.

PLANAT, Paul. "Institution d'une commission du ciment armé." La Construction Moderne vol.16 (1900-1901), 500-501.

PLANAT, Paul. "Une maison moderne." La Construction Moderne vol.9 (1893-94), 289 ff, 304 ff, 316 ff.

PLANAT, Paul. "La théorie des ciments armés." La Construction Moderne vol. 9 (1893-94); vol. 10 (1894-95).

PLUMET, Charles. "Le Salon d'architecture à la Société Nationale des Beaux-Arts." L'Architecte vol.1 (15 May 1906), 35-37.

QUESNEL, L. "Correspondance. Lettre ouverte à Henri Lavedan, de l'Académie Française." Le Béton Armé vol.16, no.179 (April 1913), 52.

QUESNEL, L. "De nos rapports avec les Architectes et les Ingénieurs spécialistes." Le Béton Armé vol.1, no.140 (January 1910), 3.

QUOST, J. "Des divers systèmes de béton de ciment armé dans la construction des bâtiments." L'Architecture vol.23, no.31 (30 July 1910), 261-263; no.32 (6 August 1910), 272-273; no.33 (13 August 1910), 277-279; no.34 (20 August 1910), 285-287; no.35 (27 August 1910), 293-294.

RABUT, Charles. "Le béton armé, ses principes, ses ressources." L'Architecture vol.23, no.18 (30 April 1910), 155-156; no.19 (7 May 1910), 161-163.

Rapports du jury international. Exposition Universelle. Paris. 1900. Groupe VI - Génie Civil. Paris, 1902.

RIVOALEN, E. "Le Rationalisme en architecture." La Semaine des Constructeurs 2nd ser., vol.1 (1886-87), 530, 553-555, 578-579, 591-592; vol. 2 (1887-88), 28-32.

RIVOALEN, E. "Causeries technologiques: fers et bétons." Encyclopédie d'Architecture 4th ser., vol.1 (1888-89), 182-184, 189-190.

RIVOALEN, E. "Planchers à l'épreuve du feu: acier et béton de ciment." Nouvelles Annales de la Construction 4th ser., vol.10 (September 1893), 138-143.

ROZIERES, Raoul. L'évolution de l'architecture en France. Paris: Ernest Leroux, 1894.

RUSKIN, John. The Seven Lamps of Architecture. London, 1849. Reprint, New York: The Noonday Press, 1961.

SALADIN, H. "L'Architecture au Salon de 1913." L'Architecture vol.26, no.23 (7 June 1913).

SAUNIER, Charles. "Une nouvelle construction en grès." L'Art décoratif vol.5 (January-June 1903), 169-175.

SAUNIER, Charles. "Nouvelles applications du grès flammé au revêtement des façades." L'Architecte vol.3, no.11 (November 1908), 83-87; no.12 (December 1908), 91-94.

SEDILLE, Paul. "L'architecture contemporaine et les industries d'art qui s'y rattachent." Bulletin mensuel de la société centrale des architectes 6th ser., vol.2 (1885), 28-33.

SEDILLE, Paul. "Du rôle de la construction dans l'architecture." Encyclopédie d'architecture 3rd ser., vol.4 (1885), 73-74.

SEMPER, Gottfried. Gottfried Semper: The Four Elements of Architecture and Other Writings. Translated by Wolfgang Herrmann and Harry F. Mallgrave. New York: Cambridge University Press, 1989.

SOREL, Georges. "Industrie. Evolution moderne de l'architecture." Revue Scientifique 4th ser., vol.3, no.21 (1895), 641-645.

TRELAT, Gaston. "Constructions en acier et en ciment armé." International Congress of Architects: Seventh session held in London 16-21 July 1906. London, 1908.

UHRY, Edmond. "Une maison à Paris." L'Art décoratif vol.6, no.71 (August 1904), 51-60.

VERA, André. "La Nouvelle Architecture." L'Architecture (September 1912), 65-67; (October- December 1912), 73-75.

VIERENDEEL, A. L'architecture métallique au XIXe siècle et l'exposition de 1889 à Paris. Bruxelles, 1890.

VIOLLET-LE-DUC, Eugène Emmanuel. L'Art russe: ses origines, ses éléments contitutifs, son apogée, son avenir. Paris, 1877.

VIOLLET-LE-DUC, Eugène Emmanuel. Dictionnaire raisonné de l'architecture française du XIe au XVIe siècle. 10 vols. Paris: B. Bance, 1854-63 (vols.1-6); Paris: A. Morel, 1864 -68 (vols.7-10).

VIOLLET-LE-DUC, Eugène Emmanuel. Entretiens sur l'architecture. 2 vols. Paris: A. Morel, 1863-72. Reprint, Bruxelles-Liège: Mardaga, 1977.

VIOLLET-LE-DUC, Eugène Emmanuel. In Encyclopédie d'Architecture vol.5, no.6 (1 June 1855).

VOGT, G. "De l'emploi de la Céramique dans la Construction." Art et Décoration vol.15 (1904).

VOIROL, Sébastien. "Où en sont les architectes ?" Montjoie! no.2 (April-June 1914), 12-13.

VON EMPERGER, Fritz. "The prevention of failures in reinforced concrete structures." Concrete and Constructional Engineering vol.4, no.5 (October 1909), 312.

ZOLA, Emile. Au Bonheur des Dames. Paris, 1883. Reprint in Les Rougon-Macquart. vol.3. Paris: Bibliothèque de la Pléiade, 1964.

ZOLA, Emile. L'Oeuvre. Paris,1888.

ZOLA, Emile. Le Ventre de Paris. Paris,1874. Reprint in Les Rougon-Macquart. vol.3. Paris: Bibliothèque, 1964.

1915-34

ABC - Beiträge zum Bauen. vol.1, nos.3/4 (1925).

ABRAHAM, Pol. "Le ciment fondu dans le bâtiment." L'Architecte n.s., vol.1 (January 1924), 2.

ABRAHAM, Pol. "Une église en béton armé; Notre-Dame du Raincy - A. et G. Perret, architectes et constructeurs." L'Architecte n.s., vol.1 (January 1924), 13-16.

ABRAHAM, Pol. "Groupe de Trois villas à Saint-Rambert l'Ile-Barbe (Rhône)." L'Architecte vol.1, no.1 (January 1924), 4-5.

ACHEL, Henri. "André Lurçat, architecte." L'Architecture vol.40, no.4 (15 April 1927), 113-116.

AGACHE, Alfred; AUBURTIN, J.-Marcel; REDONT, Edouard. Comment reconstruire nos cités détruites. Paris: Armand Colin, 1915.

ALAIN. "Matière et forme." (24 August 1921) In Préliminaires à l'esthétique. Paris: Gallimard, 1939, 93-94.

ANONYMOUS. "L'Acier dans la Construction des Immeubles." La Revue de l'Habitation vol.26, no. 107 (January 1930).

ANONYMOUS. "Le Cement Gun." Le Béton Armé no.3 (25 December 1919), 70.

ANONYMOUS. "La Construction Métallique." L'Architecture Supplément technique. no.7 (December 1929).

ANONYMOUS. Les Constructions Bessonneau. Catalogue des maisons préfabriquées de la sociétée Bessonneau, Section du ciment armé. Angers, April 1919.

ANONYMOUS. "Chronique [revue de l'Exposition à l'Ecole spéciale d'architecture]." Art et Décoration vol.45 (April 1924).

ANONYMOUS. "Une église en béton armé." La Construction Moderne vol.39, no.22 (2 March 1924), 254-256.

ANONYMOUS. "Evolution ou mort de l'ornement. Une enquête des échos d'art." L'Architecture d'Aujourd'hui vol.3, no.6 (July-August 1933), 95-96.

ANONYMOUS. "Une formule intéressante de construction rapide - L'architecte Henri Sauvage et la fabrication des maisons en usine ou à l'atelier." Art et Bâtiment (April 1928), 147-153.

ANONYMOUS. "Le gratte-ciel Américain." Acier no.3 (1931).

ANONYMOUS. "Hôtel particulier à Versailles. (S. & O.)." L'Architecte no.10 (October 1926), 80.

ANONYMOUS. "Notre enquête sur les matériaux de la construction." L'Architecture d'Aujourd'hui vol.1, no.1 (November 1930), 16-26; vol.1, no.2 (December 1930), 32-38.

ANONYMOUS. "Pour ou contre l'ornement." L'Architecture (15 June 1933), 178.

ANONYMOUS. "Procédés nord-américains de costructions métalliques d'immeubles." Acier no.3 (1929).

ANONYMOUS. "La rue Mallet-Stevens à Paris. - R. Mallet-Stevens, architecte." L'Architecte vol.4, no.12 (December 1927), 100, pl. 69-72, figs. 170-178 and 184-185.

ANONYMOUS. "Salon d'Automne, I. La Section d'Architecture." Clarté (December 1924).

ANONYMOUS. "La soirée de propagande de l'Architecture d'Aujourd'hui." L'Architecture d'Aujourd'hui vol.2, no.9 (December 1931-January 1932), 77-83.

ANONYMOUS. "Supériorité du béton armé" and "Résistance du béton armé aux tentatives de destructions boches." Le Béton Armé no.2 (25 July 1919), 26-29.

AUBURTIN, J-Marcel, and Henri BLANCHARD. La Cité de demain dans les régions dévastées. Paris: Armand Colin, 1917.

AUGROS, Paul. Béton armé. Possibilités techniques et architecturales. Paris: Ch. Massin, 1926.

BADERRE, Guillaume. "M. Auguste Perret nous parle de l'Architecture au Salon d'Automne." Paris-Journal vol.37, no.2478 (7 Decembre 1923), 5.

BADERRE, Guillaume. "Une visite à Le Corbusier-Saugnier." Paris-Journal (14 December 1923), 6.

BADERRE, Guillaume. "Seconde visite à Le Corbusier." Paris-Journal (28 December 1923), 3.

BADOVICI, Jean. "Les Constructivistes." L'Architecture Vivante vol.3, no.9 (Fall 1925), 5-10.

BADOVICI, Jean. "En Hollande. H.P. Berlage." L'Architecture Vivante vol.1 (Winter 1923), 21-25.

BADOVICI, Jean. "Entretiens sur l'Architecture vivante." L'Architecture Vivante vol.1 (Fall-Winter 1923), 12-19; vol.2 (Spring 1924), 14-20; vol. 3 (Winter 1925), 27-29.

BADOVICI, Jean. "Hôtel particulier, rue du Docteur-Blanche, par Le Corbusier et P. Jeanneret." L'Architecture Vivante vol.4, no.13 (Fall 1926), 15-16.

BADOVICI, Jean. Maisons de rapport de Charles Plumet. Paris: Albert Morancé, 1923.

BADOVICI, Jean. "Petit Hôtel particulier, à Paris, rue Nansouty, par A. et G. Perret." L'Architecture Vivante vol.2 (Spring 1924), 14-16.

BADOVICI, Jean. "Rétrospective." L'Architecture Vivante vol.4, no.13 (Fall 1926), 5-7.

BAYARD, Emile. Le Style Moderne. Paris: Garnier, 1919.

BEAUDOIN, Eugène, and Marcel LODS. "Etude sur la rationalisation. Méthodes de construction standard dans le bâtiment." Chantiers vol.1, no.2 (March 1933).

BENNETT, Thomas P. Architectural Design in Concrete. New York: Oxford University Press, 1927.

BESNARD, Charles-Henri. L'Art Décoratif Moderne et les Industries d'Art Contemporaines. Paris: Henri Laurens, 1925.

BESNARD, Charles-Henri. L'Eglise Saint-Christophe de Javel. Description raisonnée. Paris: Imprimerie J. Mersch, 1930.

BESNARD, Charles-Henri. "Les Procédés Modernes de Construction rapide." Art et Décoration (Fall 1919), 27-32.

BLANCHARD, Henri. "Reconstruction des villes. L'exposition de l'architecture régionale dans les provinces envahies." L'Architecture vol.30 (February 1917), 27-31

BLANCHE, Jacques-Emile. "Promenades à l'Exposition des Arts décoratifs." Nouvelles Littéraires (18 July 1925); (29 August 1925).

BLOC, André. "Opinions de M. Roux-Spitz." L'Architecture d'Aujourd'hui vol.1, no.2 (December 1930), 9.

BLOC, André. "La question de l'ornement." L'Architecture d'Aujourd'hui vol.3, no.1 (January-February 1932), 3-5.

BOESIGER, Willy, ed. Le Corbusier et Pierre Jeanneret. Oeuvre complète 1929-1934. Zürich: Editions H. Girsberger, 1935.

BOISSY, G. "Les temples modernes." L'intransigeant vol.14 (9 July 1923), 1.

BOULARD, Paul. "Allemagne..." L'Esprit Nouveau no.27 (November 1924), n.p.

BOURDEIX, Pierre. "Tony Garnier. Précurseur de l'Achitecture d'Aujourd'hui." L'Architecture d'Aujourd'hui no.4 (March 1931), 33-35.

BRILLANT, Maurice. "Une cathédrale moderne." La vie catholique (26 June 1926).

BRUNON-GUARDIA, Georges. "Pour ou contre l'ornement ?" Beaux-Arts vol.72, no.15 (14 April 1933), 2; no.16 (21 April 1933), 2; no.19 (12 May 1933), 2; no.20 (19 May 1933), 2.

CARON, Julien [Ozenfant]. "Une Villa de Le Corbusier 1916." L'Esprit Nouveau no.6 (March 1921), 679-704.

CASSAN, Urbain. "Les maisons métalliques françaises." Acier no.2 (August 1929).

CHARVET, Louis. "Visites d'ateliers: les constructeurs Auguste Perret." Revue des Jeunes (10 January 1927), 54-65.

CHENNEVIERE, G. "La routine et l'esprit réactionnaire à l'Ecole des Beaux-Arts." Le Quotidien (20 July 1926).

Le Ciment-roi, réalisations architecturales récentes. Paris: Librairie de la Construction Moderne, c. 1926.

CLERET DE LANGAVANT, J. "L'acier: matériau de construction." L'Architecture d'Aujourd'hui vol.1, no.1 (November 1930), 47-51.

COGNIAT, Raymond. "Une nouvelle salle de musique de A. et G. Perret." Art et Décoration vol.56 (October 1929), 128.

Compte-rendu général du Congrès Technique International de la Maçonnerie et du Béton armé. Paris, May 1928.

Les Constructions Bessonneau. Angers, April 1919.

COQUELIN, Maurice. "L'architecture moderne à la recherche d'un style d'époque." Revue foncière et immobilière (July 1929).

CORDONNIER, Louis. "Reconstitution des villes. Projet en vue de l'organisation de la reconstruction dans les régions dévastées." L'Architecture vol.32 (15 May 1919), 245-254.

DANTIN, Charles. "Constuctions civiles. L'église en béton armé du Raincy." Le Génie Civil vol.43, tome 83, no.1 (7 July 1923), 1-4.

DE BAUDOT, Anatole. L'Architecture, le passé, le présent. Paris: Henri Laurens, 1916.

[DECOURT, Raoul.] La Maison Isothermes. Procédés R. Decourt. Catalogue. Nancy-Paris-Strasbourg, 1930.

DE MOCOMBLE, Charles. Constructions Modernes. Paris: Librairie J.-B. Baillière et Fils, 1929.

DENEUX, Henri. "La nouvelle charpente de la cathédrale de Reims, en éléments de ciment armé assemblés et démontables." La Technique des Travaux no.7 (July 1926).

[DERMEE, Paul, et al.] "Domaine de l'Esprit Nouveau." L'Esprit Nouveau no.1 (October 1920).

DE TEDESCO, Napoléon. "Couverture en sheds des Ateliers J. Voirin, à Montataire." Le Constructeur de ciment armé vol.4, no.29 (February 1922), 32-33.

DE THUBERT, Emmanuel. "L'Exposition de 1937 - Fille de Jaïre." La Construction Moderne vol.49, no.36 (3 June 1934).

DE THUBERT, Emmanuel. "Un immeuble, 51-55 rue Raynouard à Paris, par A.-G. Perret Architectes." La Construction Moderne vol.50, no.10 (1934).

DONCIERES, René. "Une révolution dans l'art de construire les maisons." La Science et la Vie vol.27, no.99 (September 1925), 228-230.

DORMOY, Marie. "A. et G. Perret." L'Amour de l'Art vol.4, no.1 (January 1923), 409-416.

DORMOY, Marie. "L'architecture francaise moderne." La Revue Française de Prague vol.4, no.19 (1 July 1925), 161-170.

DORMOY, Marie. "Contre le nouveau formalisme." L'Architecture d'Aujourd'hui vol.2, no.9 (December 1931-January 1932), 4-6.

DORMOY, Marie. "Une exposition d'Art Français à Vienne." L'Art Vivant no.9 (1 May 1925).

DORMOY, Marie. "Le Faux Béton." L'Amour de l'Art vol.10, no.4 (April 1929), 128-132.

DORMOY, Marie. "Interview d'Auguste Perret sur l'exposition internationale des arts décoratifs." L'Amour de l'Art vol.6, no.5 (May 1925), 174.

DORMOY, Marie. "Le Corbusier." L'Amour de l'Art vol.9, no.5 (May 1930), 213-218.

DORMOY, Marie. "Réponse d'Auguste Perret à la brochure sur le théâtre du Werkbund à Cologne." L'Amour de l'Art vol.6, no.7 (July 1925), 239-244.

DORMOY, Marie. "Robert Mallet-Stevens." L'Amour de l'Art vol.8, no.10 (October 1927), 373-75.

DROUIN, René. "Enquête sur l'architecture moderne." L'Architecture d'Aujourd'hui vol.3, no.4 (May 1933), 3-4.

DUPONT, H. "Les nouveaux bâtiments du Service Technique des Constructions navales." La Technique des Travaux vol.8, no.6 (June 1932), 332-338.

DUPUY, Charles. "Exposition de la Cité reconstituée." L'Architecture vol.29 (August-September 1916), 135-138.

[EDITOR.] "Notre nouveau programme." Le Béton Armé no.1 (25 March 1919), 1-2.

[ENGINEER.] "Le Béton Armé après la guerre." Le Béton Armé no.1 (25 March 1919), 2-4.

FABRE, Abel. "L'Arche." La Croix (15 December 1918).

FABRE, Abel. "L'architecture régionale dans les pays envahis." La Croix (29 January 1917).

FABRE, Abel. "Propos d'architecte." La Croix (31 March 1917).

FIERENS, Paul. "Les frères Perret et l'architecture du béton armé." Journal des débats (2 August 1927).

FIERENS, Paul. "Pierre ou béton." Journal des débats (2 December 1932).

FOSCA, François. "Encore le meuble de métal." L'Amour de l'Art vol.11, no.1 (January 1930), 55.

FOSCA, François. "A propos d'une campagne contre l'art moderne." L'Amour de l'Art vol.10, no.6 (June 1929), 239.

FULCRAN [Abel Fabre]. "L'église du Raincy." La Croix (7 September 1922).

FULCRAN [Abel Fabre]. "La taille directe et la mort du praticien", La Croix (1927).

GALLOTTI, Paul. L'entrepreneur à travers les Ages. Paris: Librairie de l'Enseignement Technique, Léon Eyrolles, 1921.

GARNIER, Georges-Louis. "Auguste Perret et l'architecture moderne." La République des Arts (1925).

GARNIER, Tony. Le Cité industrielle, étude pour la construction des villes. 1917. Reprint, Paris: Philippe Sers éditeur, 1988.

GAULTIER, Louis Gaultier. Exposition de la Cité reconstituée. Esthétique et Hygiène. Rapport général. Paris, 1917.

GAUTHIER, Maximilien. "Le manifeste de l'UAM." L'Art Vivant (August 1934).

GEORGE, Waldemar. "Exposition d'Architecture et d'Art décoratif", Paris-Journal (11 April 1924).

GEORGE, Waldemar. "L'Exposition des Arts Décoratifs et Industriels de 1925. Les tendances Générales." L'Amour de l'Art vol.6, no.8 (August 1925), 283-291.

GEORGE,Waldemar. "IV. L'Art Urbain." L'Amour de l'Art vol.3, no.11 (November 1922), 358-362.

G.I. "L'Architecture moderne et les Jurys officiels." Le Bâtiment (16 September 1926).

GIEDION, Sigfried. Bauen in Frankreich - Bauen in Eisen - Bauen in Eisenbeton. Leipzig and Berlin: Klinkhardt & Biermann, 1928. [English translation: Building in France, Building in Iron, Building in Ferroconcrete. Translated by J. Duncan Berry. Santa Monica: The Getty Center for the History of Art and the Humanities, 1995.]

GIEDION, Sigfried. "La leçon de l'Exposition du 'Werkbund' à Stuttgart en 1927." L'Architecture Vivante vol.6, no.20 (Summer 1928), 38.

GIEDION, Sigfried. "Das Neue Haus." Das Kunstblatt vol.10, no.4 (April 1926), 153-157.

GIEDION, Sigfried. "Neues Bauen in Frankreich." Neue Zürcher Zeitung (17 March 1927).

GIEDION, Sigfried. "Zur Situation der fransözischen Architektur." Der Cicerone vol.19 (January 1927), 15-23; (March 1927), 174-189; (May 1927), 310-317.

GINSBURGER, Roger. "France. The Development of New Ideas in Construction and Form [Abridged translation of 1930 text]" Rassegna no.38 (June 1989), 68-87.

GINSBURGER, Roger. Frankreich. Die entwicklung der neuen ideen nach konstruktion und form. Vienna: Anton Schroll & Co., 1930.

GINSBURGER, Roger. "A propos de la crise du logement. La construction rationnelle à l'étranger." La Nature no.2803 (15 February 1929), 152-158.

GLEIZES, Albert. "A l'exposition, que pensez-vous du ... Pavillon de Russie." Bulletin de la Vie Artistique vol.6, no.11 (1 June 1925), 235.

GOISSAUD, A. "Notes sur l'oeuvre des architectes A.-G. Perret. Maison de contremaître à Grand-Quevilly." La Construction moderne vol.41, no.44 (1926), 521-524.

GRANET, André. "La taylorisation dans l'entreprise." Le Moniteur des Travaux Publics, de l'Entreprise et de l'Industrie (17 January 1918), 1.

GREBER, Jacques. Organisation des Travaux d'Architecture aux Etats-Unis. Paris: Librairie Centrale des Beaux-Arts, 1919.

GROPIUS, Walter. "Das flache Dach: Internationale Umfrage über die technische Durchführbarkeit horizontal abgedeckter Dächer und Balkone." Bauwelt XVII (April 1926).

GROPIUS, Walter. Internationale Architektur. Bauhausbücher no. 1. Munich, 1925.

GUADET, Paul. "L'esthétique du béton armé." L'Emulation Organe de la Société Centrale d'Architecture de Belgique. (1926).

GUILBERT, A. "L'Architecture moderne et l'Ecole des Beaux-Arts." Le Journal (19 August 1926).

GUILBERT, A. "Toléra-t-on la proscription des artistes novateurs?" Comoedia (17 July 1926).

HAUTECOEUR, Louis. Considérations sur l'art d'aujourd'hui. Paris: Librairie de France, 1929.

HAUTECOEUR, Louis. In L'Architecture (1925).

HAUTECOEUR, Louis. "Le Salon d'Automne." Gazette des Beaux-Arts vol.66, 5th period, tome 10 (October 1924).

HAUTECOEUR, Louis. "Trois théories de l'architecture." L'Architecture vol.37, no.7 (10 April 1924), 80.

HEGEMANN, Werner. "Van de Velde, Chaos & les Danois." French translation of an article published in Wasmuth Monatshefte für Baukunst (December 1925).

HERMANT, Jacques. La reconstruction des villes détruites. 1916.

HILBERSEIMER, Ludwig, and Julius VISCHER. Beton als Gestalter. Stuttgart: Julius Hoffmann, 1928.

HITCHCOCK, Henry-Russell. Modern Architecture: Romanticism and Reintegration. New York: Payson & Clarke, 1929.

H. M. "La Cité Seurat de Montsouris." La Technique des Travaux (September 1927).

HUYGHE, René. "Le Salon d'Automne." L'Architecture vol.40, no.12 (December 1927).

IMBERT, Charles. "Französiche Architekten ihrer Zeit, A. u. G. Perret." Deutsche Bauzeitung vol.60 (13 November 1926), 737-742.

IMBERT, Charles. "Le quartier artiste de Montsouris, la Cité Seurat, 101 rue de la Tombe-Issoire (Paris)." L'Architecture vol.40, no.4 (April 1927), 101-112.

IMBERT, Gabriel. "La querelle des anciens et des modernes. III. Les discussions d'école et l'opinion publique." Le Bâtiment Illustré vol.20, no.6 (June 1932), 13-14

IMBERT, Gabriel. "IV. 'La défense de l'Architecture et de la Décoration moderne'." Le Bâtiment Illustré vol.20, no.7 (July 1932), 11.

IMBERT, Gabriel. "Le cri d'alarme du 'Bâtiment Français'." Le Bâtiment Illustré vol.20, no.9 (September 1932), 7.

JAMOT, Paul. A.-G. Perret et l'architecture du béton armé. Paris-Bruxelles: G. Vanoest, 1927.

JAMOT, Paul. "Les frères Perret et la basilique Sainte Jeanne d'Arc." L'Art Vivant (1 July 1926), 498-501.

JAMOT, Paul. "1905: date décisive pour l'architecture du béton armé." L'Art Vivant (1 September 1926), 642-644.

JAMOT, Paul. "Notre-Dame du Raincy." Gazette des Beaux-Arts vol.65 (September-October 1923), 199-210.

JANNEAU, Guillaume."Auguste Perret et M. Van de Velde." Bulletin de la vie artistique vol.6 (1 September 1925), 381-383.

JANNEAU, Guillaume. "Chez les cubistes, Notre enquête - III. Réponse de Mallet-Stevens." Bulletin de la Vie Artistique vol. 5, no.23 (1 Decembre 1924), 532-534.

JANNEAU, Guillaume. "L'exposition des arts techniques de 1925. Que sera, demain, le logis ?" Bulletin de la Vie Artistique vol.4, no.3 (1 February 1923), 64-65; vol.4, no.11 (1 June 1923), 229-231; vol.4, no.19 (1 October 1923), 414.

JANNEAU, Guillaume. "Les 'Moyens' nouveaux de la Construction." L'Exportateur Français (27 May 1926), 435-437.

JANNEAU, Guillaume. *Technique du décor intérieur moderne*. Paris: Albert Morancé, 1928.

JEANNERET, Charles-Edouard, and Amédée OZENFANT. *Après le cubisme*. Paris: Ed. des Commentaires, 1918.

JOURDAIN, Frantz. "L'oeuvre d'Eiffel et l'architecture du fer." *Bulletin de la Vie Artistique* vol.5, no.2 (15 January 1924), 41-42.

KAHN, Gustave. "Art." *Mercure de France* vol.171 (15 April 1924), 505.

KOECHLIN, R. "L'art français moderne n'est pas 'Munichois'." *L'Art français moderne* no.1 (January 1916), 1-37.

LABADIE, Jean. "Les cathédrales de la cité moderne." *L'Illustration* vol.80, no.4145 (12 August 1922), 131-135.

LANDRY, Lionel. "L'exposition des arts décoratifs. L'architecture: section française." *Art et Décoration* (June 1925), 177-213.

LE CORBUSIER. *Almanach d'Architecture Moderne*. Paris: Editions Crès, 1926.

LE CORBUSIER. "Architecture d'époque machiniste." *Journal de psychologie normale et pathologique* (15 January-15 March 1926), 20. Reprint, Turin: Bottega d'Erasmo, 1975.

LE CORBUSIER. *L'Art Décoratif d'Aujourd'hui*. Paris: Editions Crès, 1925.

LE CORBUSIER. "Ce Salon d'Automne." *L'Esprit Nouveau* no.19 (December 1923), n.p.

LE CORBUSIER. "Ce Salon d'Automne." *L'Esprit Nouveau* no.28 (January 1925), 2332-2335.

LE CORBUSIER. *Croisade ou le Crépuscule des Académies*. Paris: Editions Crès, 1933.

LE CORBUSIER. "Die Eroberung des Flachen Daches." *Das neue Frankfurt* no.7 (December 1927).

LE CORBUSIER. "L'Exposition à l'Ecole Spéciale d'Architecture." *L'Esprit Nouveau* no.23 (May 1924), n.p.

LE CORBUSIER. "Fünf Punkte zu einer neuen Architektur." *Die Form* vol.2, no.9 (1927).

LE CORBUSIER. "L'heure de l'architecture." *L'Esprit Nouveau* no.28 (January 1925), 2386-2391.

LE CORBUSIER. "Janvier 1929." *L'Architecture vivante. Le Corbusier and Pierre Jeanneret*. 2nd series. Paris: Morancé, 1929.

LE CORBUSIER. *Une maison - un palais*. Paris: Editions Crès, 1928.

LE CORBUSIER. "Maison de l'Union des Coopératives à Moscou." Cahiers d'Art no.4 (1929), n.p.

LE CORBUSIER. " Où en est l'architecture?" L'Architecture Vivante vol.5, no.17 (Fall 1927), 5-28.

LE CORBUSIER. "Pour bâtir: standardiser et tayloriser." Bulletin du Redressement Francais (May 1928).

LE CORBUSIER. "Pourra-t-on bientôt se loger? Une enquête sur la loi Loucheur." Bulletin du Redressement Francais (September 1928).

LE CORBUSIER. Précisions sur un état présent de l'architecture et de l'urbanisme. Paris: Crès, 1930.

LE CORBUSIER. "Réflexions à propos de la loi Loucheur." La Revue des vivants (August 1928).

LE CORBUSIER. "Salon d'Automne: architecture." L'Esprit Nouveau no.19 (December 1923), n.p.

LE CORBUSIER. "La signification de la Cité-Jardin du Weissenhof, à Stuttgart." L'Architecture Vivante vol.6, no.19 (Spring 1928), 9-15.

LE CORBUSIER. Urbanisme. Paris: Editions Crès, 1925.

LE CORBUSIER. Vers une architecture. Paris: Editions Crès, 1923. New edition. Paris: Editions Vincent, Fréal & Cie, 1958.

LE CORBUSIER. "Vers le Paris de l'époque machiniste." Bulletin du Redressement Francais (February 1928).

LE CORBUSIER, and Pierre JEANNERET. "Analyse des éléments fondamentaux du problème de la Maison minimum." La Revue de l'Habitation vol.25, no.106 (December 1929); vol.26, no.107 (January 1930).

LE CORBUSIER, and Pierre JEANNERET. Oeuvre complète 1910-1929, edited by O. Stonorov. W. Boesiger, Zürich: Girsberger, 1937. Reprint, Zurich: Artemis, 1964.

LE CORBUSIER, and Amadée OZENFANT. "L'angle droit." L'Esprit Nouveau no.18 (November 1923), n.p.

LE CORBUSIER-SAUGNIER. "Des yeux qui ne voient pas... II. Les Avions." L'Esprit Nouveau no.9 (June 1921).

LE CORBUSIER-SAUGNIER. "Maisons en série." L'Esprit Nouveau no.13 (December 1921), 1525-1542.

LE CORBUSIER-SAUGNIER. "Les Maisons Voisin." L'Esprit Nouveau no.2 (November 1920), 211.

LE CORBUSIER-SAUGNIER. "Trois Rappels: le plan." L'Esprit Nouveau no.4 (January 1921), 457-470.

LEON, Paul, ed. "Architecture." Rapport général, Exposition internationale des Arts Décoratifs et Industriels modernes, Paris, 1925. vol.2. Paris, Librairie Larousse, 1928.

LEON, Paul. "L'architecture dans les provinces envahies." Les Arts no.157 (1917), 12-19.

LEON, Paul. La renaissance des ruines. Paris: Henri Laurens, 1918.

LIAUSU, Jean-Pierre. "Doit-on réglementer les cabinets d'architectes ?" Comoedia (30 June 1926).

LOOS, Adolf. "Ornement et crime." L'Esprit Nouveau no.2 (November 1920), 159-168.

LOUVET, Albert. "Les églises modernes. L'église Notre-Dame du Raincy, par MM. Perret, constructeurs." L'Architecture vol.37, no.19 (1924), 263-270.

LURÇAT, André. Architecture. Paris: Editions Au Sans Pareil, 1929.

LURÇAT, André. "L'architecture française; son bilan avant l'effort actuel: la tradition abandonnée depuis 1820, un siècle de perdu." 7 Arts no.5 (12 December 1926).

LURÇAT, André. "Architecture Internationale." Deuxième exposition annuelle du Comité Nancy-Paris. Exhibition catalogue March 1926.

[LURÇAT, André.]. "Un groupe d'ateliers par André Lurçat." Clarté (January 1925).

LURÇAT, André. "Der Weg zur Terrasse." Special issue, "Das Flache Dach." Das Neue Frankfurt vol.1, no.7 (October-December 1927), 173-175.

MACDONALD, William. Reconstruction in France. New York: MacMillan, 1922.

MAGNE, Henri-Marcel. L'architecture. Paris: F. Rieder, 1922.

MAGNE, Henri-Marcel. "L'Architecture et les Matériaux Nouveaux." Art et Décoration vol.36 (May-June 1919), 85-96.

MAGNE, Henri-Marcel. Les enseignements de l'Exposition internationale des Arts décoratifs et Industriels modernes. Paris, Léon Eyrolles Editeur, 1926.

MAGNE, Henri-Marcel. L'Enseignement de l'art appliqué aux métiers. Paris: Henri Laurens, 1918.

MAGNE, Henri-Marcel. Vue d'ensemble sur l'Exposition internationale des Arts décoratifs et Industriels modernes. Paris, 1925.

La Maison Isotherme, Procédés R. Decourt. Nancy-Paris-Strasbourg, 1930.

MALKIEL-JIRMOUNSKY, Myron. "Réflexions sur l'architecture contemporaine III. La France." Supplément au Bulletin du Redressement Français (1 September 1928), 1-4.

MALKIEL-JIRMOUNSKY, Myron. "Tendances de l'Architecture contemporaine." L'Amour de l'Art vol.9, no.10 (October 1928), 361-371.

MALKIEL-JIRMOUNSKY, Myron. Les tendances de l'architecture contemporaines. Paris: Librairie Delagrave, 1930.

MALLET-STEVENS, Robert. "Architecture Moderne." L'Architecture d'Aujourd'hui vol.3, no.8 (1932).

MALLET-STEVENS, Robert. Une Cité Moderne. Paris: Ch. Massin, 1922.

MALLET-STEVENS, Robert. "Défense de l'architecture et de la décoration moderne." L'Intransigeant (1932).

MALLET-STEVENS, Robert. "Frank Lloyd Wright et l'architecture nouvelle." Wendingen no.9 (1925). In The Life-Work of the American Architect Frank Lloyd Wright, edited by H.T. Wijdeveld. Santpoort: C. A. Mees, 1925, 92-93. Reprint, New York: Horizon Press, 1965.

MALLET-STEVENS, Robert. In Gazette des Sept Arts vol.1, no.1 (15 December 1922).

MALLET-STEVENS, Robert. "Une prochaine exposition française de maquettes d'architecture moderne." Comoedia (9 February 1923).

MALLET-STEVENS, Robert. "Les raisons de l'architecture moderne dans tous les pays." Conferencia - Journal de l'Université des Annales vol.20, no.24 (1 December 1926), 585-597.

MARGERAND, J. "Le pavillon Suisse à la Cité Universitaire de Paris." La Construction Moderne vol.49, no.14 (31 December 1933), 218-224.

MAUCLAIR, Camille. "L'affreux nudisme." L'Architecture vol.46, no.3 (15 March 1933), 83.

MAUCLAIR, Camille. "L'architecture bolchévisante." L'architecture vol.46, no.3 (15 March 1933), 82.

MAUCLAIR, Camille. L'architecture va-t-elle mourir ? Paris: Editions de la Nouvelle Revue Critique, 1933.

MAUCLAIR, Camille. "La grande pitié de l'architecture 'moderne'." Le Figaro (8 April 1933).

MAUCLAIR, Camille. "Mort de l'architecture 'inutile'." Le Figaro (2 February 1933).

MAUCLAIR, Camille. "Pour la défense des ouvriers d'art." L'Ami du peuple (9 April 1933).

MAURITAIN, Jacques. Art et scolastique. 1920.

MAYER, Marcel. A. et G. Perret. Paris: Librairie de France F. Sant'Andrea, n. d. [1928].

MAYER, Marcel. "L'architecture du béton armé. Les romantiques." L'Amour de l'Art vol.9, no.3 (March 1928), 81-87.

MAYER, Marcel. "L'architecture du béton armé. Une Oeuvre Classique." L'Amour de l'Art vol.9, no.7 (July 1928), 266-269.

MAYER, Marcel. "De Cluny au béton armé. Les oeuvres nouvelles de A. et G. Perret." La Revue de Bourgogne vol.16, no.4 (15 April 1926), 230-238.

MAYER, Marcel. "Eglises en béton armé." La Revue de Bourgogne vol.15, no.7 (15 July 1925), 357-366.

MENKES, E. "La leçon de l'industrie." Chantiers vol.1, no.3 (April-May 1933), 1-2.

MENKES, E. "Notre programme." Chantiers vol.1, no.1 (January-February 1933), 1.

MENKES, E. "Le Pavillon Suisse à la Cité Universitaire." Chantiers. Organe technique de l'Architecture d'Aujourd'hui vol.1, no.1 (January-February 1933), 5.

MESNIL, Jacques. "Une exposition d'architecture." L'Humanité (13 April 1924).

MESNIL, Jacques. "Les expositions." L'Humanité (28 October 1923).

MICHEL, André. "Projets d'Abris provisoires pour les paroisses dévastées." Journal des Débats (17 February 1916).

MORICE, Gabriel. "Concours pour la construction d'habitations métalliques ouvert par la Société des Forges de Strasbourg." L'Architecture vol.41, no.7 (15 July 1928), 207-210.

MOUREY, Gabriel. Henri Sauvage. Paris: Librairie de France, 1928.

NOULIN-LESPES, P. "La reconstruction des églises dans les régions dévastées." Le Béton Armé n.s., no.3 (25 December 1919), 50-52.

OFFICE DU BATIMENT ET DES TRAVAUX PUBLICS. Conférence du Bâtiment pour la Reconstitution des Régions dévastées. Paris, 1918.

ONDERDONK, Francis S. The Ferro-Concrete Style. New York: 1928.

OUD, J.J.P. "Architecture and Standardisation in Mass Construction." De Stijl vol.1, no.7 (1918), 77-79

OUD, J.J.P. "Les possibilités architectoniques de demain." Bulletin de l'Effort Moderne no.4 (April 1924), 1-5; no.5 (May 1924), 9-13; no.6 (June 1924), 13-15.

OZENFANT, Amédée. Art. Paris: Jean Budry, 1928.

P. B. "Les maisons d'acier." Revue Foncière et immobilière (October 1929).

PEIRANI, P. "La Cité du Champ des Oiseaux." La Technique des Travaux no.8 (August 1933), 469-478.

"Perret." Special issue. L'Architecture d'Aujourd'hui vol.3, no.7 (1932).

PERRET, Auguste. "L'architecture à l'Exposition des Arts décoratifs." Arts et Métiers vol.78, no.62 (1925), 433-436.

PERRET, Auguste. "Architecture: Science et Poésie." La Construction Moderne vol.48 (2 October 1932), 2-3.

PERRET, Auguste. "Le béton de ciment armé dans les constructions." République (24 December 1933).

PERRET, Auguste. "Construction. Architecture." La Journée industrielle (15 June 1933).

PERRET, Auguste. "Construction. Architecture." Revue d'Art et d'Esthétique no.1-2 (June 1935), 41-50.

PERRET, Auguste. "Le Logis [interview with Auguste Perret]." La Revue Française (23 December 1925).

PERRET, Auguste. "L'oeuvre d'Eiffel et l'architecture du fer." Bulletin de la Vie Artistique vol.5, no.6 (15 March 1924), 130.

PERRET, Auguste. "Vers un style nouveau en architecture. Construisons avec des matériaux apparents... nous dit M. Auguste Perret." L'Intransigeant (21 June 1930).

PETIT, Léon. "L'esthétique dans les constructions en béton armé." Le Génie Civil vol.43, tome 83, no.24 (15 December 1923), 585-586.

PICARD, Ernest. "La Cité reconstituée aux Tuileries." L'Architecture vol.29 (August-September 1916), 138-144.

[PORCHER, J.] "Planches 25 à 29 - Salle de concerts de l'Ecole normale de musique, à Paris - A. et G. Perret, architectes." L'Architecte vol.8, no.5 (May 1930).

PREVOST, Jean. "A. G. Perret et l'architecture du béton armé." Nouvelle Revue Française (November 1927), 698-701.

RAMBOSSON, Yvanhoé. "L'archevêché fera-t-il un nouveau concours?" Comoedia (23 June 1926).

RAMBOSSON, Yvanhoé. "Au Concours Jeanne d'Arc le beau projet des Perret n'est même pas classé!..." Comoedia (9 June 1926).

RAMBOSSON, Yvanhoé. "Encore le concours de la basilique Jeanne-d'Arc." Comoedia (29 June 1926).

RAMBOSSON, Yvanhoé. "Une exposition d'architecture." Comoedia (30 March 1924).

RAMBOSSON, Yvanhoé. "Un important article de Paul Jamot." Comoedia (17 July 1926).

RAMBOSSON, Yvanhoé. "La nouvelle église du Raincy." Art et Décoration (January 1924), 1-7.

RAMBOSSON, Yvanhoé. "Une salle de concert construite par A. et G. Perret." L'Illustration no.4509 (3 August 1929), 123.

RAMBOSSON, Yvanhoé. "Le salon d'Automne. III. Les Arts appliqués." L'Amour de l'Art vol.4, no.11 (November 1923).

REGAMEY, Raymond. "Pour l'église votive Ste.-Jeanne d'Arc." Journal de l'Est (14 July 1926).

REINACH, Joseph. Le village reconstitué. Bruxelles-Paris: Van Oest, 1917.

R.G. "Faut-il réformer la composition du jury d'architecture des Beaux-Arts." Le Figaro (16 June 1926).

ROBERTSON, Howard. "Buildings by the Brothers Perret. A Notable Contribution towards the Architecture of Concrete." The Architect & Building News (4 March 1927), 400-402.

ROSENTHAL, Léon. Villes et villages français après la guerre. Paris: Payot, 1918.

ROTH, Alfred. Zwei Wohnhäuser von Le Corbusier und Pierre Jeanneret. Stuttgart: Wedekind & Co., 1927.

ROUX-SPITZ, Michel. "L'architettura moderna in Francia." Architettura e Arti Decorative vol.3, no.1 (1924), n.p.

ROUX-SPITZ, Michel. "Contre le nouveau formalisme." L'Architecture d'Aujourd'hui vol.3, no.3 (April 1932), 61-63.

SAUNIER, Charles. "L'architecture française du temps présent et les matériaux nouveaux." La Renaissance de l'art français et des industries de luxe vol.3, no.5 (May 1920), 222-27.

SAUVAGE, Henri. "Les Tendances de l'Architecture Moderne." L'Amour de l'Art vol.3, no.10 (October 1922), 333-334.

SEE, Charles-Edmond. "Une villa moderne à Saint-Cloud. Par M. Moreux, architecte D.P.L.G." La Construction Moderne vol.43, no.38 (17 June 1928), 445-450.

SOLLAR, Fabien. "Enquête. Evolution ou mort de l'ornement ?" Art et Décoration (May 1933), i-iv; (June 1933), v-vii; (July 1933), i-vi; (September 1933), i-vii; (October 1933), i-v; (November 1933), i-ii.

SOUCHON, Pierre. "L'épiderme de la maison." Le Bâtiment illustré no.2 (February 1931).

T. "La nature en ciment armé." Bulletin de la Vie Artistique vol.6, no.15 (1 August 1925), 329.

THIEBAULT-SISSON. "A propos du Salon de l'Union des Artistes." L'Entreprise française (25 February 1932), 9-10.

TISSERAND, Ernest. "L'évolution de l'architecture moderne." L'Art et les Artistes vol.14, no.76 (April 1927), 238-245.

TISSERAND, Ernest. "Le meuble de métal et son avenir." L'Amour de l'Art vol.10, no.11 (November 1929), 418-427.

TOURNANT, Jacques. "Grands Magasins Decré à Nantes." L'Architecture d'Aujoud'hui no.8 (November 1931), 37-45.

UMBDENSTOCK, Gustave. "La défense des métiers de main des artistes et artisans français." L'Architecture vol.45 (15 March 1932), 134-138.

UMBDENSTOCK, Gustave. L'évolution architecturale au XXe siècle. Paris: Imprimerie A. Tournon, 1932.

URBAIN, Pierre. "L'Exposition de l'Amicale- Impressions personnelles et réflexions des autres." Bulletin de l'Amicale no.5 (June 1924), 4.

VAGO, Pierre. "Un immeuble nouveau." Le Maître d'Oeuvre vol.5, no.48 (1930).

VAGO, Pierre. "Quelques immeubles nouveaux." L'Architecture d'Aujourd'hui vol.2, no.5 (July 1931), 12-20.

VAGO, Pierre. "Rue Marbeuf." Le maître d'oeuvre vol.5, no.41-42 (1930).

VAILLANT, A. "L'entrepreneur et..." L'Architecture vol.34, no.16 (25 August 1921), 6-8.

VAILLANT, Alcide. "'Simplifions' en ordonnant." La Construction Moderne (15 April 1915), 1-2.

VAILLANT, Alcide. Théorie de l'architecture. Paris: Nouvelle Librairie Nationale, 1919.

VAILLAT, Léandre. La Cité renaissante. Paris: Larousse, 1918.

VAILLAT, Léandre. "La Cité renaissante. Le régionalisme en architecture." Le Temps (19 August 1916).

VAILLAT, Léandre. Le décor de la vie. Paris: La Renaissance du Livre, 1918.

VAILLAT, Léandre. "Du ciment armé. son esthétique." Les Arts Français no.20 (August 1918), 149-158.

VAN DE VELDE, Henry. "Devant l'architecture." L'Architecture Vivante vol.3 (Winter 1925), 24-26.

VAN DOESBURG, Theo. On European Architecture. Basel-Berlin-Boston: Birkhäuser Verlag, 1990.

VAN DOESBURG, Theo. Scritti di arte e di architettura. Edited by Sergio Polano. Rome: Officina Edizioni, 1979.

VAN DOESBURG, Theo. "Vernieuwingspogingen in de Fransche architecture." Het Bouwdedrijf vol.1, no.4 (October 1924), 173-177.

VARENNE, Gaston. "L'Art urbain et le mobilier au Salon d'Automne." Art et Décoration tome 44 (December 1923).

VARENNE, Gaston. "Quelques constructions récentes d'André Lurçat." La Demeure française no.3 (Fall 1926), 55-58.

VARENNE, Gaston. "Le Salon d'Architecture. L'Art Décoratif et l'Art Urbain." L'Amour de l'Art vol.5, no.2 (December 1924), 369-376.

VAUXCELLES, Louis. "La Semaine Artistique." L'Ere nouvelle (27 March 1924).

VAUXCELLES, Louis. "La vie artistique." L'Eclair (2 March 1924).

VEISSIERE, Gabriel. "Les Architectes du groupe 'Styl'." L'Architecture vol.36, no.22 (25 November 1923), 370.

VEISSIERE, Gabriel. "Le Salon des artistes décorateurs." L'Architecture vol.37, no.13 (10 July 1924).

VEISSIERE, Gabriel. "Le Salon d'Automne." L'Architecture vol.37, no.23 (1923).

VOIRIN, P. "L'architecture française de l'exposition." Le Rationaliste 6th serie, no.25 (November-December 1925).

WRIGHT, Frank Lloyd. "Idées sur l'architecture." L'Architecture d'Aujourd'hui vol.2, no.9 (December 1931-January 1932), 3-4.

WYBO, Georges. Réflexions et croquis sur l'architecture au Pays de France. Paris: Hachette, 1918.

ZAHAR, Marcel. "L'architecture contemporaine. Jean-Charles Moreux." L'Art Vivant no.99 (1 February 1929).

ZAHAR, Marcel. "L'Architecture Vivante. Gabriel Guévrékian." L'Art Vivant no.97 (1 January 1929).

ZAHAR, Marcel. "Henri Sauvage." L'Art Vivant no.88 (15 August 1928), 628-631.

ZAHAR, Marcel. "Parlons architecture: André Lurçat nous dit..." La Patrie (April 1928).

ZAHAR, Marcel. "Les principes et les projets de M. Le Corbusier." L'Art Vivant no.87 (1 August 1928), 588-590.

ZAMACOIS, Miguel. "Autour d'un Arbre en ciment armé." Le Gaulois (20 June 1925).

ZARRAGA, Angel. "M. Le Corbusier envisage la question des matériaux colorés de revêtement." Excelsior (29 December 1932).

ZARRAGA, Angel. "La peinture à fresque doit être un 'matériau' nous dit M. Auguste Perret." Excelsior (28 December 1932).

ZARRAGA, Angel. "Une solution à la crise des Arts plastiques. Notre enquête auprès des architectes sur les possibilités d'une renaissance du travail d'équipe." Excelsior (28-30 December 1932).

ZERVOS, Christian. "Réflexions d'Auguste Perret sur l'architecture." Les Arts de la Maison (Spring 1924).

POST-1934

ABRAM, Joseph. "A. et G. Perret une monographie. 1e partie: architecture, entreprise et expérimentation." Research report. Nancy: L.H.A.C. / B.R.A., 1989.

ABRAM, Joseph. "Aux confins de la culture cubiste." In Pierre Chareau architecte, un art intérieur. Paris: Editions du Centre Pompidou, 1993.

ABRAM, Joseph. "Oscar Nitzchké, la Maison de la Publicité - Paris 1935." Architecture, Mouvement, Continuité no. 6 (1984), 66-79.

ABRAM, Joseph. "Perret et l'école du classicisme structurel (1910-1960)." 2 vols. Research report, S.R.A.-Ecole d'Architecture de Nancy, 1985.

ABRAM, Joseph. "An Unusual Organization of Production: the building firm of the Perret Brothers, 1897-1954." Construction History vol.3 (1987), 75-93.

ACHE, J. B. "Les précurseurs de la révolution architecturale 1850-1930." L'Architecture d'Aujourd'hui vol.34, nos.113-114 (1964).

AGEE, William C. Raymond Duchamp-Villon 1876-1918. New York: Walker and Co., 1967.

ANDERSON, Stanford. "Deutscher Werkbund - the 1914 debate: Hermann Muthesius versus Henry van de Velde." In Companion to Contemporary Architectural Thought. Edited by Ben Farmer & H. Louw. London: Routledge, 1993, 463-467.

BANHAM, P. Reyner. Theory and Design in the First Machine Age. London: The Architectural Press, 1960.

BASDEVANT, Denise. Bourdelle et le Théâtre des Champs-Elysées. Paris, 1982.

BECKER, Jean-Jacques. "Les destructions de la guerre de 1914-1918: coût, ampleur, conséquences démographiques..." In Reconstruction et modernisation. La France après les ruines 1918... 1945... Paris: Archives nationales, 1991.

BENTON, Tim. "La réponse de Le Corbusier à la loi Loucheur." In Le Corbusier, une encyclopédie. Edited by Jacques Lucan. Paris: Editions du Centre Georges Pompidou/CCI, 1987, 236-239.

BENTON, Tim. "Six houses." In Le Corbusier Architect of the Century. London: Arts Council of Great Britain, 1987, 44-109.

BENTON, Tim. The Villas of Le Corbusier 1920-1930. New Haven-London: Yale University Press, 1987.

BENTON, Tim and Charlotte, eds. Architecture and Design 1890-1939. New York, 1975.

BOIS, Yve-Alain, and TROY, Nancy. De Stijl et l'architecture en France. Liège-Bruxelles: Mardaga, 1985.

BORSI, Franco, and Ezio GODOLI. Paris 1900. New York: Rizzoli, 1977.

BOUDON, Françoise. "Recherche sur la pensée et l'oeuvre d'Anatole de Baudot, 1834-1915." AMC no.28 (March 1973), 2-67.

BRESSANI, Martin. "1903-1933, cronaca di un'architettura." Rassegna no.28 (December 1986), 16-31.

BRESSANI, Martin. "Rationalism and the Organic Analogy in Fin-de-Siècle Paris: Auguste Perret and the Building at 25b rue Franklin." Master's thesis, MIT, 1985.

BRIOLLE, Cécile; FUZIBET, Agnès; MONNIER, Gérard. La Villa Noailles de Mallet-Stevens. Marseille: Parenthèses, 1990.

BROOKS, H. Allan, ed. The Le Corbusier Archive. 32 volumes. New York: Garland, 1982.

BRUNHAMMER, Yvonne. "Viollet-le-Duc et l'Art Nouveau: influence d'une méthode." In Viollet-le-Duc. Paris: Réunion des Musées Nationaux, 1980, 375-78.

CHOAY, Françoise. "Techniciens et architectes autour de 1900." Art de France vol.3 (1963), 311-320.

CINQUALBRE, Olivier. "France 1913-1925. Taylor dans le bâtiment, une idée qui fait son chemin." In Architecture et industrie passé et avenir d'un mariage de raison. Paris: CCI/Centre Georges Pompidou, 1983.

CINQUALBRE, Olivier, and GUIHEUX, Alain. Pierre Chareau architecte, un art intérieur, Paris: CCI/Centre Georges Pompidou, 1993.

CINQUALBRE, Olivier, and GUIHEUX, Alain. Tony Garnier. L'oeuvre complète. Paris: CCI/Centre Georges Pompidou, 1990.

CLAUSEN, Meredith. Frantz Jourdain and the Samaritaine. Leiden: E.J. Brill, 1987.

COHEN, Jean-Louis. André Lurçat 1894-1970 Autocritique d'un moderne. Paris: IFA-Mardaga, 1995.

COHEN, Jean-Louis. "L'architecture d'André Lurçat (1894-1970): autocritique d'un moderne." Ph.D. diss. EHESS, Paris, 1985.

COHEN, Jean-Louis. Le Corbusier et la mystique de l'URSS. Bruxelles-Liège: Pierre Margaga Editeur, 1987.

COHEN, Jean-Louis. "Sigfried Giedion, de *Bauen in Frankreich* à *Espace, temps, architecture*." Paper presented at the Société Française des Architectes, Paris, 8 January 1991.

COLLINS, Peter. Concrete: The Vision of a New Architecture. London: Faber & Faber, 1959.

COLLINS, Peter. "The new brutalism of the 1920s: the effect of economic restraints at Notre-Dame du Raincy." Society of Architectural Historians Journal vol.33, no.3 (1974), 233.

COLLINS, Peter. Splendeur du béton: les prédécesseurs et l'oeuvre d'Auguste Perret. (Translation of Concrete: The Vision of a New Architecture.) Paris: Editions Hazan, 1995.

CURTIS, William J. R. "Ideas of Structure and the Structure of Ideas: Le Corbusier's Pavillon Suisse." Journal of the Society of Architectural Historians vol.40 (December 1981), 295-310.

DAMISCH, Hubert. "Introduction." E.-E. Viollet-le-Duc, l'Architecture raisonnée, Paris, 1964.

DELHUMEAU, Gwenaël. "Le béton armé et le Ministère des Travaux Publics: la circulaire de 1906." Paper presented at the third meeting of the DRAST, Paris, METT, 8-9 November 1993.

DELHUMEAU, Gwenaël. "The buvette of the spa of Miers, 1910-11. Concrete without doctrine." Rassegna no.49 (1992), 49-50.

DELHUMEAU, Gwenaël. "Hennebique and Building in Reinforced Concrete around 1900." Rassegna no.49 (1992), 15-25.

DELHUMEAU, Gwenaël. "La maison en ciment armé de François Hennebique à Bourg-la-Reine." Revue d'histoire de l'art (1990), 75-87.

DE SIMONE, Rosario. Ch.E. Jeanneret- Le Corbusier Viaggio in Germania 1910-1911. Roma: Officina Edizioni, 1989.

DORMOY, Marie. Souvenirs et portraits d'amis. Paris, 1962.

DUCROS, Françoise. "Ozenfant." Le Corbusier, une encyclopédie. Edited by Jacques Lucan. Paris: Editions du Centre Georges Pompidou/CCI, 1987, 279-81.

DUMONT, Marie-Jeanne. "The Philosophers' Stone: Anatole de Baudot and the French Rationalists." Rassegna no.49 (1992), 36-43.

EPRON, Jean-Pierre. "L'éclectisme technique." Les Cahiers de la recherche architecturale no.29 (1992), 81-90.

FANELLI, Giovanni, and Roberto GARGIANI. Auguste Perret. Bari: Laterza, 1990.

FANELLI, Giovanni, and Roberto GARGIANI. Perret e Le Corbusier, confronti. Roma-Bari: Laterza, 1990

FANELLI, Giovanni, and Roberto GARGIANI. Il principio del rivestimento. Rome-Bari: Laterza, 1994.

FOUCART, Bruno. "La *cathédrale synthétique* de Louis-Auguste Boileau." Revue de l'Art no.3 (1969), 49-66.

FOUCART, Bruno. "Paul Valéry devant l'architecture de son temps, d'Eupalinos à Auguste Perret." In Paul Valéry et les Arts. Paris: Actes Sud, 1995, 37-50.

FRAMPTON, Kenneth. "Le Corbusier's Designs for the League of Nations, the Centrosoyus, and the Palace of the Soviets, 1926-1931." The Le Corbusier Archives vol.3. New York-Paris: Garland Publishing and Fondation Le Corbusier, 1982, ix-xxii.

FRAMPTON, Kenneth. "Louis I Kahn and the New Monumentality, 1944-1972." Design Book Review no.28 (Spring 1993), 8.

FRAMPTON, Kenneth. "The other Le Corbusier: primitive form and the linear city 1929-52." In Le Corbusier Architect of the Century. London: Arts Council of Great Britain, 1987, 29-34.

FRAMPTON, Kenneth. Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture. Cambridge-London: MIT Press, 1995.

GABETTI, Roberto, and Carlo OLMO. Le Corbusier e "L'Esprit Nouveau". Third edition. Turin: Einaudi, 1988.

GABETTI, Roberto, and Carlo OLMO, eds. "Prezentatione." In Ch.-E. Jeanneret Gris (Le Corbusier), Almanach d'Architecture Moderne. Reprint of Almanach d'Architecture Moderne. Turin: Bottega D'Erasmo, 1975.

GARGIANI, Roberto. Auguste Perret 1874-1954, Teoria e opere. Milan: Electa, 1993.

GAUTHIER, Maximilien. Le Corbusier ou l'architecture au service de l'homme. Paris: Denoël, 1944.

GIEDION, Sigfried. Space, Time and Architecture: The Growth of a New Tradition. Cambridge: Harvard University Press, 1941.

GREEN, Christopher. Cubism and Its Enemies. New Haven: Yale University Press, 1987.

GREGH, Eleanor. "The Dom-ino Idea." Oppositions nos. 15-16 (Winter-Spring 1979), 61-87.

GUBLER, Jacques. ABC, Architettura e Avanguardia 1924-1928. Milan, 1983.

GUBLER, Jacques. "La Chaux-de-Fonds." In Le Corbusier, une encyclopédie. Edited by Jacques Lucan. Paris: Editions du Centre Georges Pompidou/CCI, 1987, 222-30.

GUBLER, Jacques. "Prolegomeni a Hennebique." Casabella no.485 (November 1982), 40-47.

GUBLER, Jacques. "Viollet-le-Duc et l'architecture métallique: adoption du fer et tutelle de la maçonnerie." Archithèse vol.10, no.4 (1980), 43-47.

GUENE, Hélène. "Facciata in ceramica per un edificio in calcestruzzo." Rassegna 28 (December 1986) 42-47.

JANNIERE, Hélène. "'L'Architecture Vivante' e 'Cahiers d'Art'." Casabella no.603 (July-August 1993), 46-53.

JOLY, Pierre. "La villa à Croix." Rob Mallet-Stevens. Architecture, mobilier, décoration. Paris: Action Artistique de la Ville de Paris - Philippe Sers, 1986.

KIRSCH, Karin. The Weissenhofsiedlung. New York: Rizzoli, 1989.

KUIPERS, Marieke C. "Experiments in building houses in concrete." In Il Modo di costruire. Roma: Edilstampa, 1988, 365-74.

LEGAULT, Réjean. "L'appareil de l'architecture moderne. Notes sur la question du matériau 1900-1925." Les Cahiers de la recherche architecturale no.29 (1992), 53-66.

LEGAULT, Réjean. "La circulation de l'image." In Le Béton en représentation. Mémoire photographique de l'entreprise Hennebique 1890-1930. Paris: Hazan, 1993, 77-94.

LEGAULT, Réjean. "Paris 1925: an exhibition pavilion." and "Material and Modernity" Rassegna no.49 (March 1992), 55, 58-65.

LEMOINE, Bertrand. L'Architecture du fer. France: XIXe siècle. Seyssel: Champ Vallon, 1985.

LEMOINE, Bertrand. "Viollet-le-Duc et l'architecture métallique." In Viollet-le-Duc. Paris: Réunion des Musées Nationaux, 1980, 248-55.

LEVIN, Miriam R. Republican Art and Ideology in Late Nineteenth-Century France. Ann Arbor, Michigan: UMI, 1986.

LEVIN, Miriam R. When the Eiffel Tower was New: French Visions of Progress at the Centennial of the Revolution. Mount Holyoke College Art Museum, 1989.

LEVINE, Neil. "Architectural Reasoning in the Age of Positivism: The Neo-Grec Idea of Henri Labrouste's Bibliothèque Sainte-Geneviève." 2 vols. Ph.D. diss., Yale University, 1975.

LEVINE, Neil. "The Book and the Building: Hugo's Theory of Architecture and Labrouste's Bibliothèque Ste-Geneviève." In The Beaux-Arts and Nineteenth-century French Architecture. Edited by Robin Middleton. Cambridge: MIT Press, 1982, 138-73.

LIPSTADT, Hélène, and H. MENDELSOHN. "Architectes et ingénieurs dans la presse: polémique, débat, conflit." Paris: CORDA / IERAU, 1980.

LOUPIAC, Claude. "Le ballet des architectes." In 1913: Le Théâtre des Champs-Elysées. Paris: Réunion des Musées Nationaux, 1987, 22-52.

LOWMAN, Joyce. "Corb as structural rationalist. The formative influence of the engineer Max DuBois." The Architectural Review vol.160, no.956 (1976), 229-233.

LOYER, François. "De Viollet-le-Duc à Tony Garnier: la passion du rationalisme." In L'Architecture de l'Art Nouveau. Edited by Frank Russell. Paris: Berger-Levrault, 1982.

LOYER, François. Paris XIXe: l'immeuble et la rue. Paris: Hazan, 1987.

LOYER, François. "Sauvage, or the renunciation." In Henri Sauvage 1873-1932. Bruxelles: AAM, 1978.

LOYER, François, et al. Henri Sauvage. Les immeubles à gradins. Bruxelles-Liège: IFA/Mardaga, 1987.

MALLGRAVE, Harry F., ed. Otto Wagner: Reflections on the Raiement of Modernity. Santa Monica: The Getty Center for the History of Art and the Humanities, 1993.

MARREY, Bernard. "Qui est l'architecte du Théâtre des Champs-Elysées." L'Architecture d'Aujourd'hui no.174 (July-August 1974), 114-115.

MARREY, Bernard. La brique à Paris. Paris: Picard/Editions du Pavillon de l'Arsenal, 1991.

MATTEONI, Dario. "The 16 patents of Le Corbusier 1918-1961." Rassegna no.46 (June 1991), 70-79.

MCLEOD, Mary. "Architecture or Revolution: Taylorism, Technocracy, and Social Change." Art Journal vol.43 (Summer 1983), 132-47.

MIDDLETON, Robin. "Colour and cladding in the nineteenth century." Daidalos no.51 (March 1994).

MIDDLETON, Robin, and David WATKIN. Neoclassical and Nineteenth Century Architecture. New York: Harry N. Abrams, 1980.

MINNAERT, Jean Baptiste. "Henri Sauvage, architecte (1873-1932)." 5 vols. Ph.D. diss., Paris IV - Sorbonne, November 1993.

MONNIER, Gérard. L'Architecture en France. Une histoire critique 1918-1950. Paris: Philippe Sers, 1990.

OCKMAN, J. "A Villa of Le Corbusier, 1916." Oppositions nos.15/16 (Winter/Spring 1979), 187-197.

OECHSLIN, Werner. "Allemagne. Influences, confluences et reniements." In Le Corbusier, une encyclopédie. Edited by Jacques Lucan. Paris: Editions du Centre Georges Pompidou/CCI, 1987, pp.33-39.

OECHSLIN, Werner. "Les Cinq Points d'une Architecture Nouvelle." Assemblage no.4 (October 1987), 83-93.

OECHSLIN, Werner. Stilhülse und Kern: Otto Wagner, Adolf Loos und der evolutionäre Weg zu modernen Architektur. Zurich: Ernst & Sohn, 1994.

OECHSLIN, Werner. "Storia e stile in Gropius." Rassegna vol.5, no.15 (September 1983), 10-12.

PASSANTI, Francesco. "The Skyscrapers of the Ville Contemporaine." Assemblage no.4 (October 1987), 53-65.

PETIT, Jean. Le Corbusier Lui-même. Genève, 1970.

PICON, Antoine; POTIE, Philippe; SEITZ, Frédéric. "Les enterprises de construction métallique en France." Preliminary research report. Paris, June 1993.

PLOEGAERTS, Léon, and Pierre PUTTEMANS. L'oeuvre architecturale de Henry Van de Velde. Bruxelles-Québec: Atelier Vokaer-Presses de l'Université Laval, 1987.

PODRO, Michael. The Critical Historians of Art. New Haven - London: Yale University Press, 1982.

POMMER, Richard. "The Flat Roof: A Modernist Controversy in Germany." Art Journal no.43 (Summer 1983).

POMMER, Richard and OTTO, Christian F. Weissenhof 1927 and the Modern Movement in Architecture. Chicago and London: The University of Chicago Press, 1991.

POUPEE, Henri. "Magne, Lucien (1849-1916)." In Les Professeurs du Conservatoire National des Arts et Métiers. Edited by C. Fontanon and A. Grelon. Vol.1. Paris: CNAM, 1994, 169-81.

RAGOT, Gilles. "Jean-Charles Moreux et la tradition française." Research report. Paris: IFA, 1988.

RAGOT, Gilles. "Le mouvement moderne 1922-1933. Exigences et compromis." 3 vols. Ph.D. diss., Paris, Paris IV-Sorbonne, October 1993.

REICHLIN, Bruno. "Das einfamilienhaus von Le Corbusier und Pierre Jeanneret auf dem Weissenhof, eine Strukturanalyse." In Fünf Punkte in der Architekturgeschichte. Ed. by K. Medici-Hall. Basel, Boston, Stuttgart: Birkhäuser Verlag, 1985, 150-187.

REICHLIN, Bruno. "Für und wider das Langfenster. Die Kontroverse Perret-Le Corbusier." Daidalos no.13 (1984), 65-77.

REICHLIN, Bruno. "Le Corbusier vs De Stijl." In De Stijl et l'architecture en France. Edited by Yve-Alain Bois and Nancy Troy. Liège-Bruxelles: Mardaga, 1985, 91-108.

REICHLIN, Bruno. "La 'Petite maison' à Corseaux. Une analyse structurale." In Le Corbusier à Genève 1922-1932. Lausanne: Payot, 1987, 119-34.

REICHLIN, Bruno. "The single-family dwelling of Le Corbusier and Pierre Jeanneret at the Weissenhof." In In the Footsteps of Le Corbusier. Edited by Carlo Palazzolo and Riccardo Vio. New York, Rizzoli, 1991, 37-57.

ROWE, Colin. The Mathematic of the Ideal Villa and Other Essays. Cambridge: The MIT Press, 1976.

SADDY, Pierre. "Perret (Auguste) (1874-1954)." In Le Corbusier, une encyclopédie. Edited by Jacques Lucan. Paris: Editions du Centre Georges Pompidou/CCI, 1987, 300.

SERENYI, Peter. Le Corbusier in Perspective. New Jersey: Prentice-Hall, 1975.

SEARING, Helen. "Betondorp: Amsterdam's Concrete Garden Suburb." Assemblage no.3 (July 1987).

SEITZ, Frédéric. L'Ecole spéciale d'architecture 1865-1930. Paris: Picard, 1995.

SILVER, Kenneth E. Esprit de Corps: The Art of the Parisian Avant-Garde and the First World War, 1914-1925. Princeton: Princeton University Press, 1989.

SILVERMAN, Debora. Art Nouveau in Fin-de-Siècle France: Politics, Psychology and Style. Berkeley and Los Angeles: University of California Press, 1989.

SIMONNET, Cyrille. "Matériau et architecture. Le béton armé: origine, invention, esthétique." 3 volumes. Ph.D. diss., Paris, EHESS, January 1994.

STEINER, Frances H. French Iron Architecture. Ann Arbor, Michigan: UMI, 1984.

SUMI, Christian. "L'immeuble clarté et la conception de la 'maison à sec'." In Le Corbusier à Genève 1922-1932. Lausanne: Payot, 1987, 93-112.

SUMI, Christian. "Wanner (Edmond) (1898-1965)." In Le Corbusier, une encyclopédie. Edited by Jacques Lucan. Paris: Editions du Centre Georges Pompidou/CCI, 1987, 477-78.

SUMMERSON, John. Heavenly Mansions. New York: W.W. Norton, 1963.

TAYLOR, Brian Brace. Le Corbusier at Pessac. Cambridge and Paris: Harvard University and Fondation Le Corbusier, 1972.

TAYLOR, Brian Brace. "Le Corbusier's Prototype Mass Housing: 1914-1928." Ph.D. diss. Cambridge, Harvard University, 1974.

TISE, Sizanne. "Manifeste 1934." In Les Années UAM 1929-1958. Paris: Musée des Arts Décoratifs, 1988.

TREUTTEL, GARCIAS, TREUTTEL "Le squelette et la jeune fille." Research report, Paris, BRA/Nantes, 1991.

TROY, Nancy. Modernism and the Decorative Arts in France: Art Nouveau to Le Corbusier. New Haven and London: Yale University Press, 1991.

TURNER, Paul V. The Education of Le Corbusier. New York-London: Garland, 1977.

TURNER, Paul V. "Frank Lloyd Wright and the Young Le Corbusier." Journal of the Society of Architectural Historians vol.42, no.4 (December 1983).

VIGATO, Jean-Claude. L'architecture régionaliste, France 1890-1950. Paris: Editions Norma, 1994.

VIGATO, Jean-Claude. "Le jeu des modèles. Les modèles en jeu." Research report, CEMPA-Ecole d'Architecture de Nancy, 1980.

VIGATO, Jean-Claude. "Moderne, encore moderne, toujouts moderne ! Les tribulations du théâtre des Champs-Elysées." Les Cahiers de la recherche architecturale no.12 (1982), 24-39.

VITOU, Elizabeth. Gabriel Guévrékian 1900-1970. Paris: Connivences, 1987.

VON MOOS, Stanislaus. "Le Corbusier und Gabriel Voisin." In Avantgarde und Industrie. Edited by C. Smeenk. Delft, 1983.

VON MOOS, Stanislaus. "Le Corbusier et Loos." In L'Esprit Nouveau. Le Corbusier et l'industrie 1920-1925. Strasbourg, 1987, 122-33.

WIGLEY, Mark. White Walls, Designer Dresses: The Fashioning of Modern Architecture. Cambridge: The MIT Press, 1995.

WILL-LEVAILLANT, Françoise. "Norme et forme à travers L'esprit Nouveau." In Le retour à l'ordre dans les arts plastiques et l'architecture (1919-1925). C.I.E.R.E.C.-Université de Saint-Etienne, 1975, 241-76.

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Source: Le Corbusier and Pierre Jeanneret, Oeuvre Complète de 1910-1929, (Zürich: Editions Dr. H.Girsberger, 1943), p.23.

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Source: H. Allen Brooks, ed., The Le Corbusier Archive, vol.1 (New York-London-Paris: Garland Publishing and Fondation Le Corbusier, 1982), p.60.

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Source: Jean-Louis Cohen, André Lurçat 1894-1970: autocritique d'un moderne, (Paris-Liège: IFA-Mardaga, 1995), p.26.

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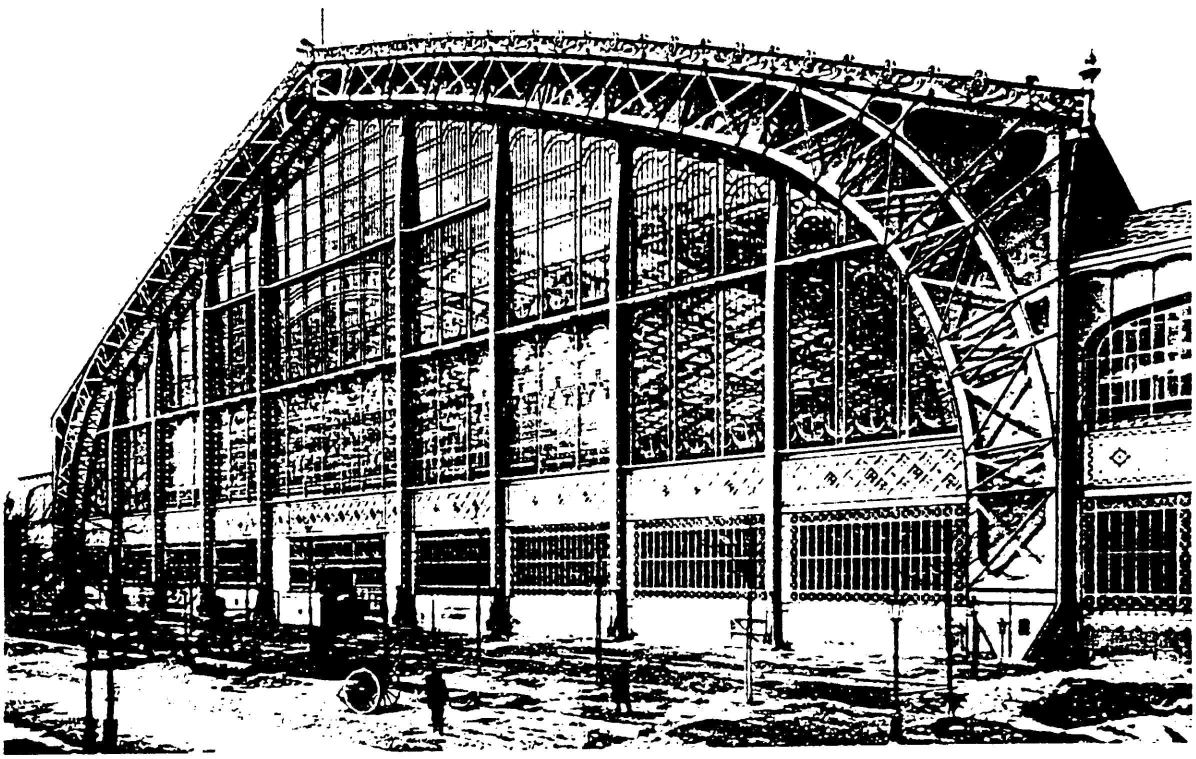

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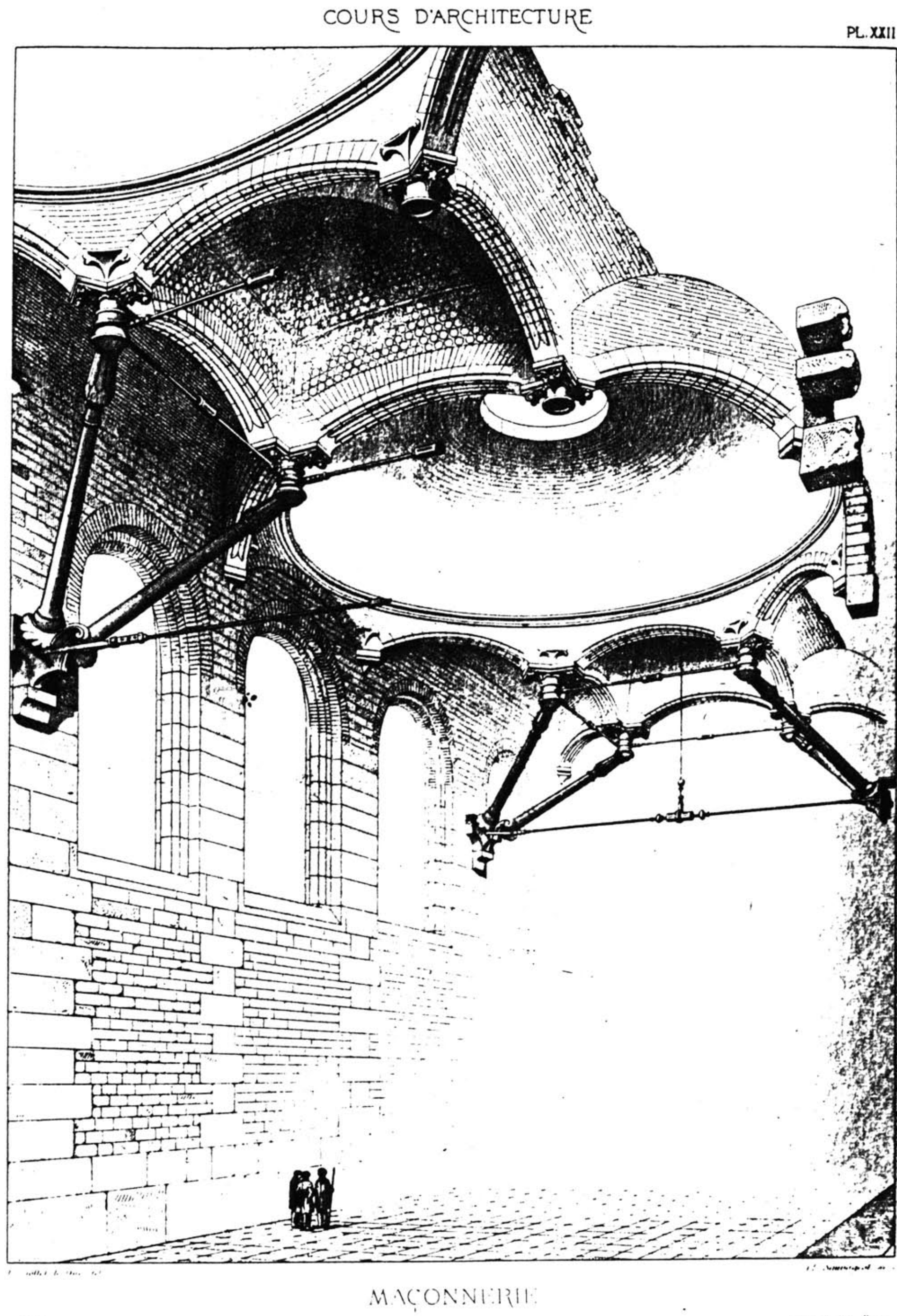
Source: Frances H. Steiner, French Iron Architecture, (Ann Arbor, Michigan: UMI, 1984), p. 75.



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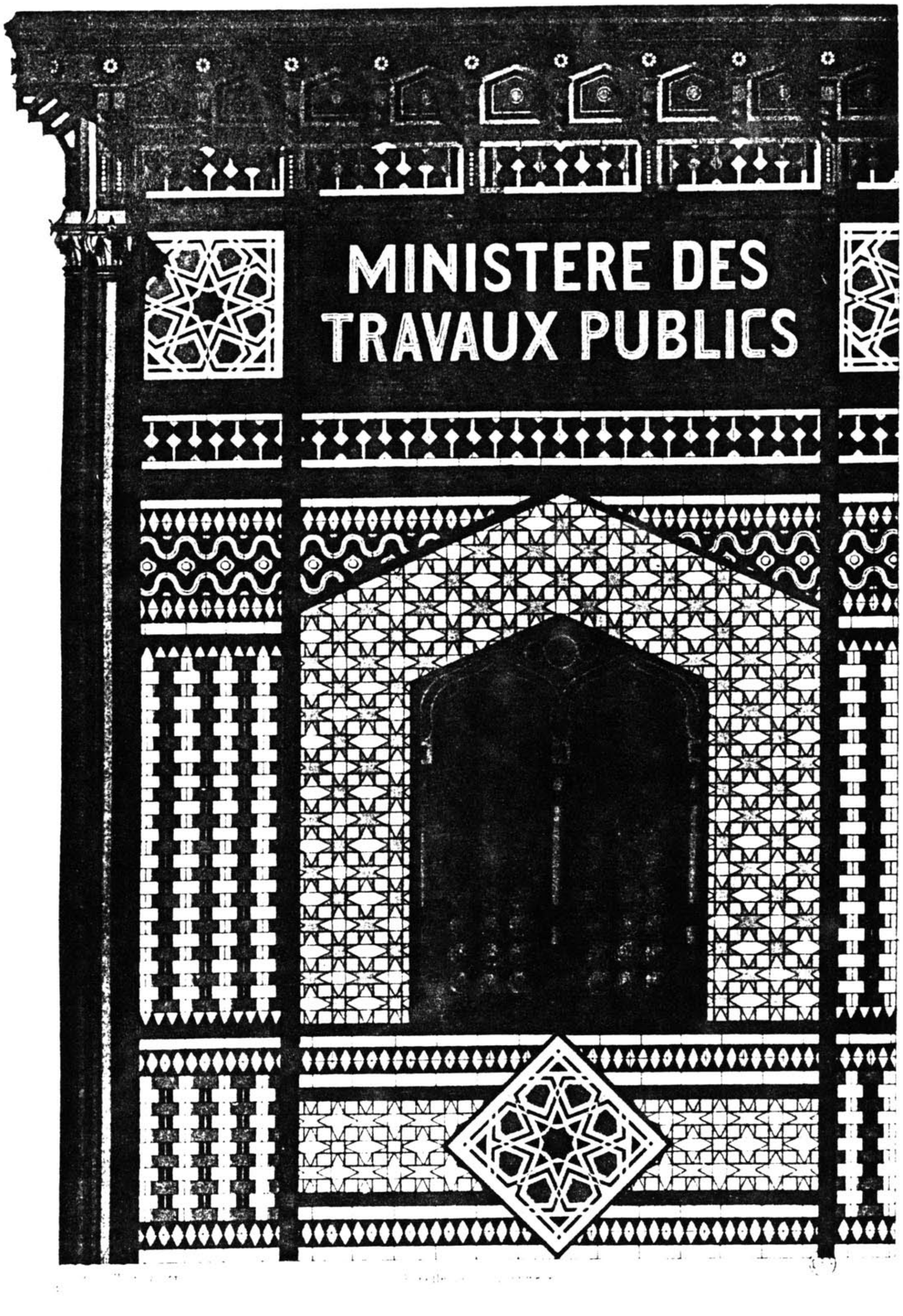

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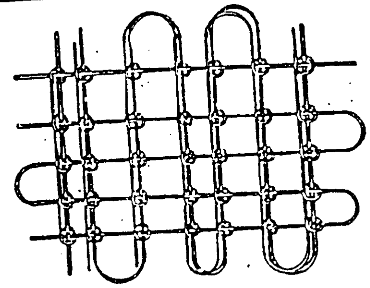

Fig. 6.

neau d'ossature tissé de la surface ou faire passer des boucles au travers du panneau et les remailler comme ci-dessous

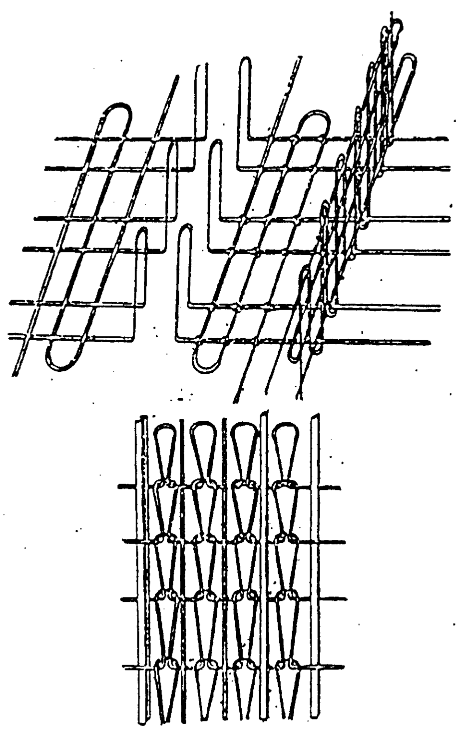

Fig. 7

Cette disposition comme celle de la spirale donne beaucoup de solutions de tissages.

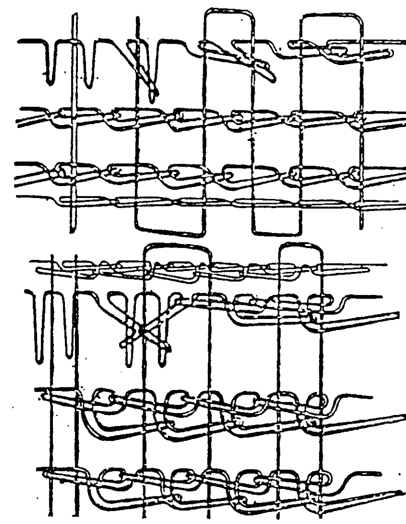

Fig. 8

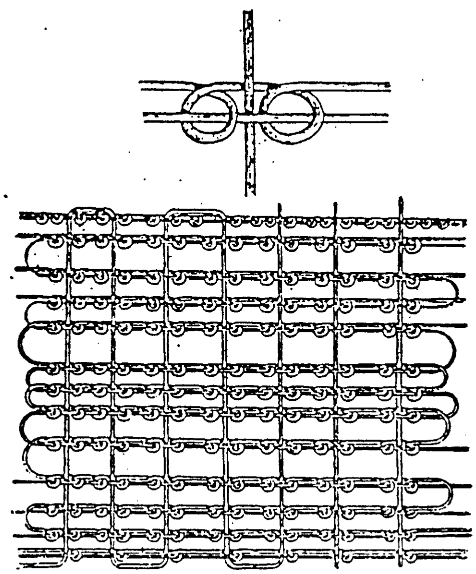

Fig. 9

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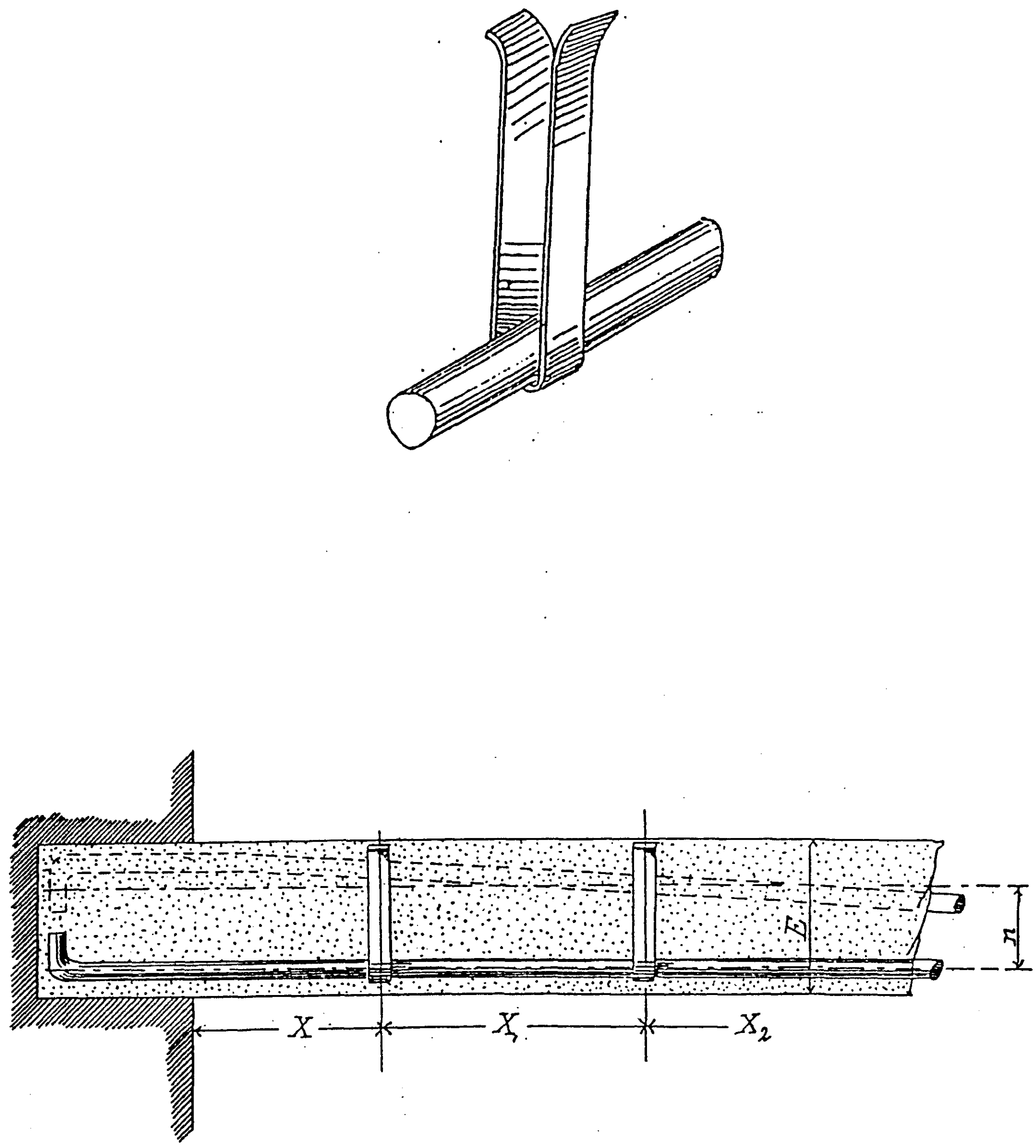
Source: Cyrille Simonnet, "Materiau et Architecture. La béton armé: origine, invention, esthétique," vol.2 (Ph.D. diss., Paris, EHESS, January 1994), p.238



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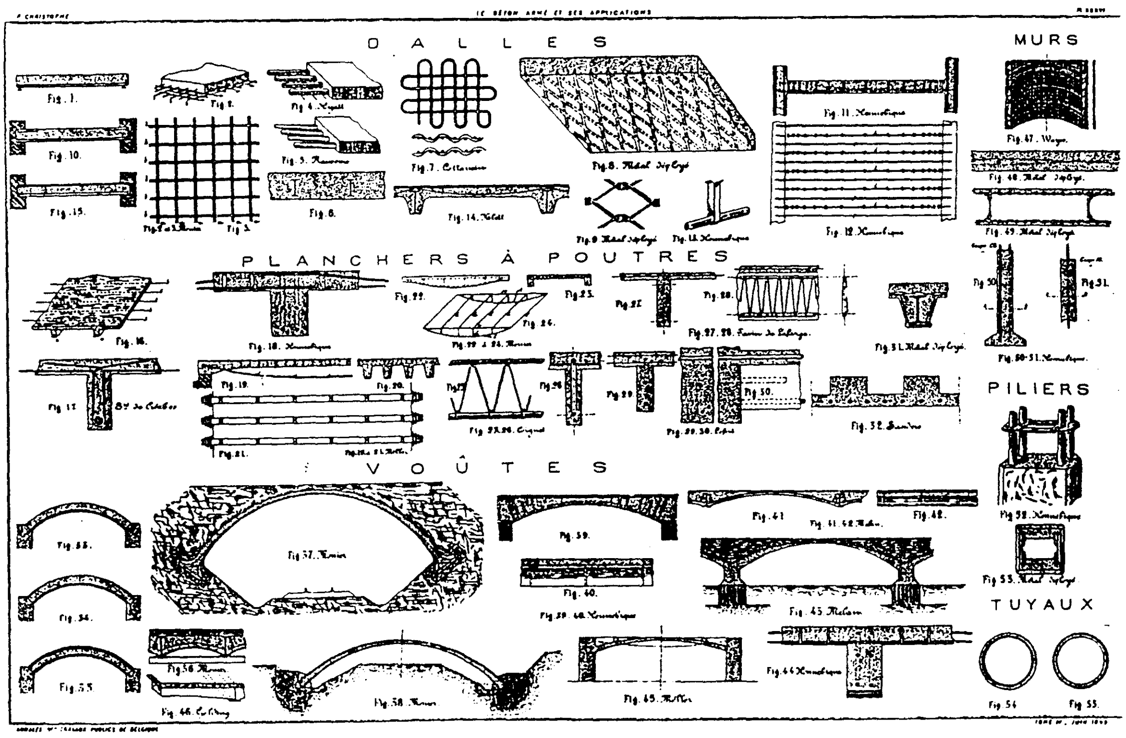
Source: Simonnet, p.197.



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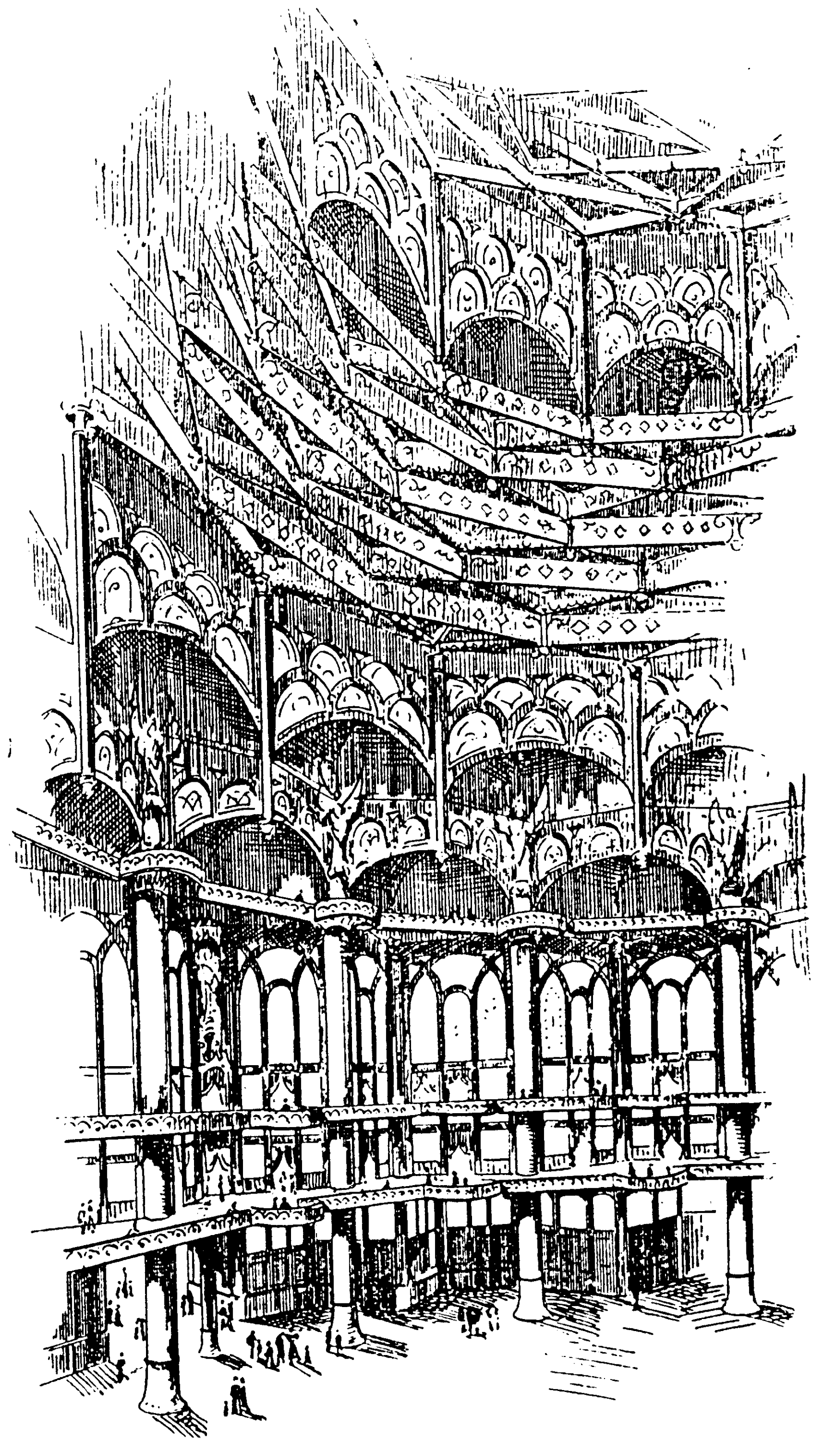

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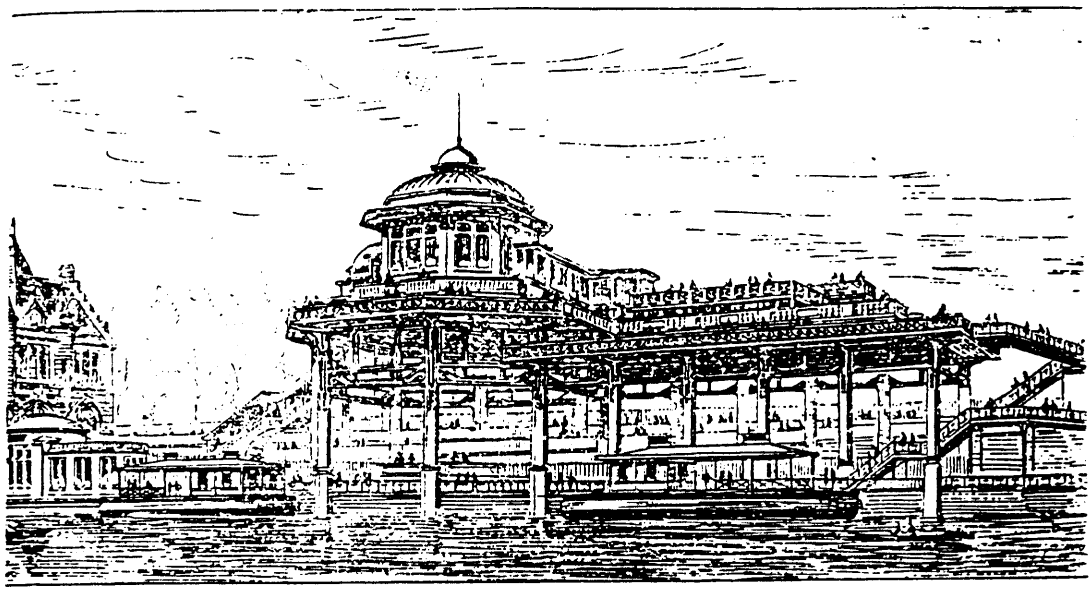

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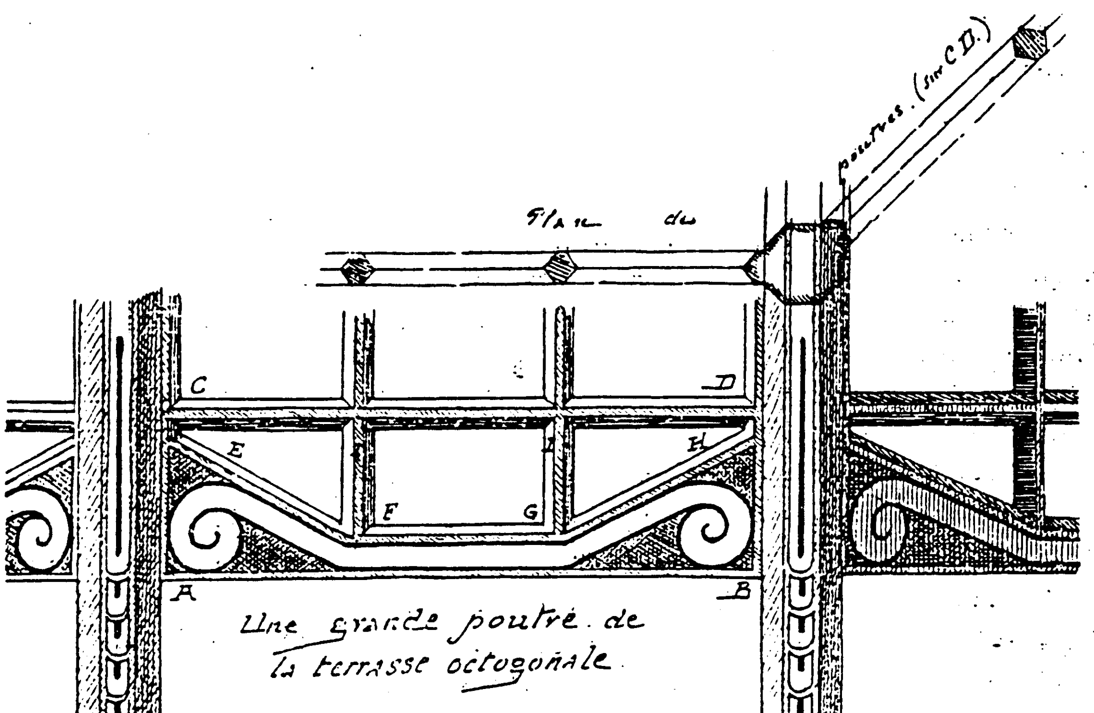

Fig. 5

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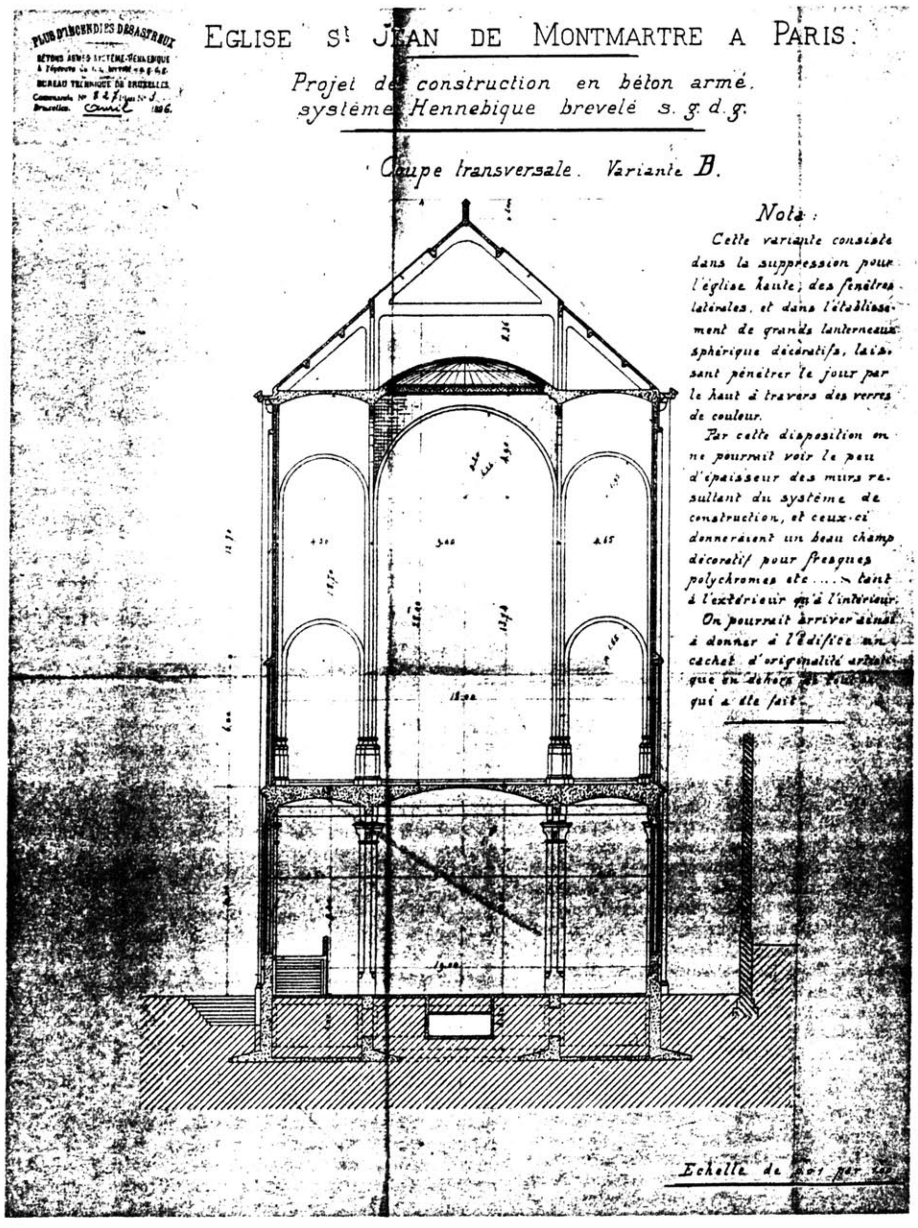
Source: Boileau, "Un projet de terrasse en ciment armé,"
<u>L'Architecture</u>, vol.19, no.2 (13 January 1906), pp.12-14.



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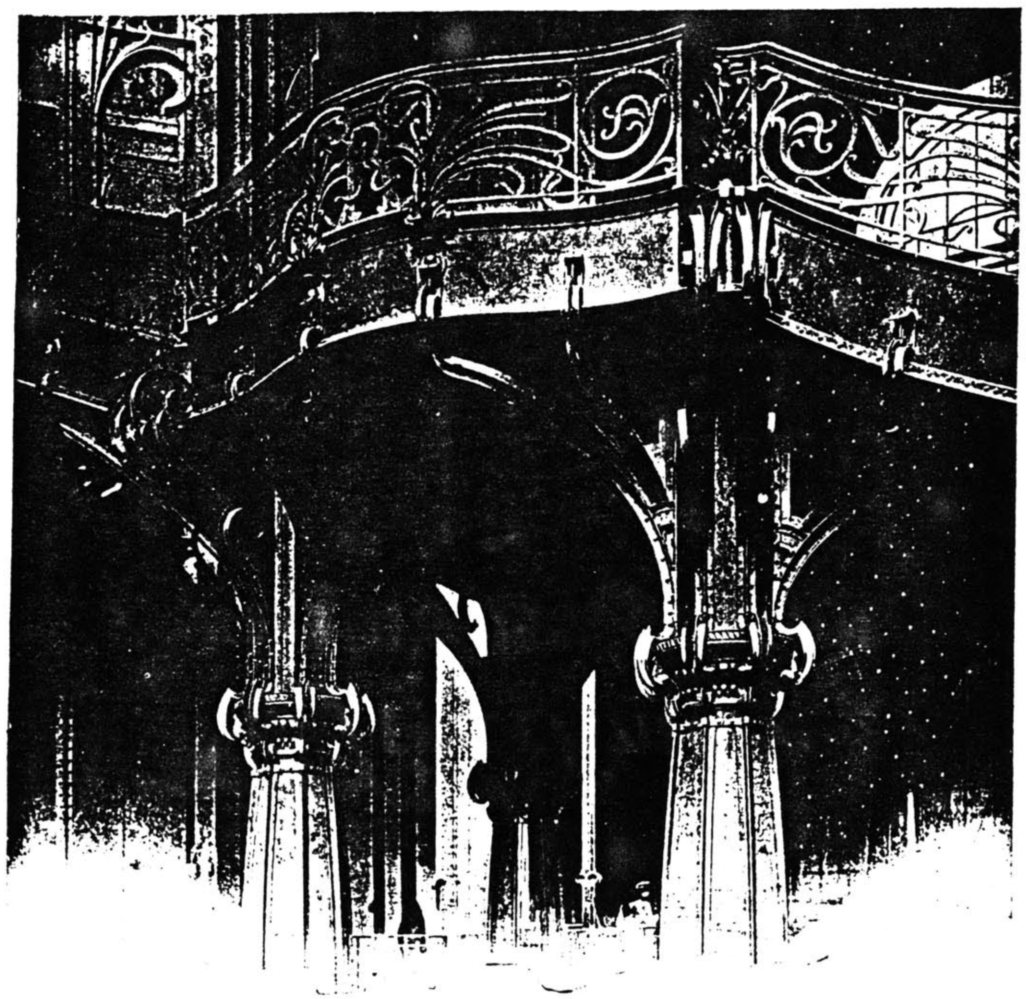
Source: Gwenaël Delhumeau, "Hennebique e la costruzione in calcestruzzo armato intorno al 1900," Rassegna no.49 (1992), p.20.



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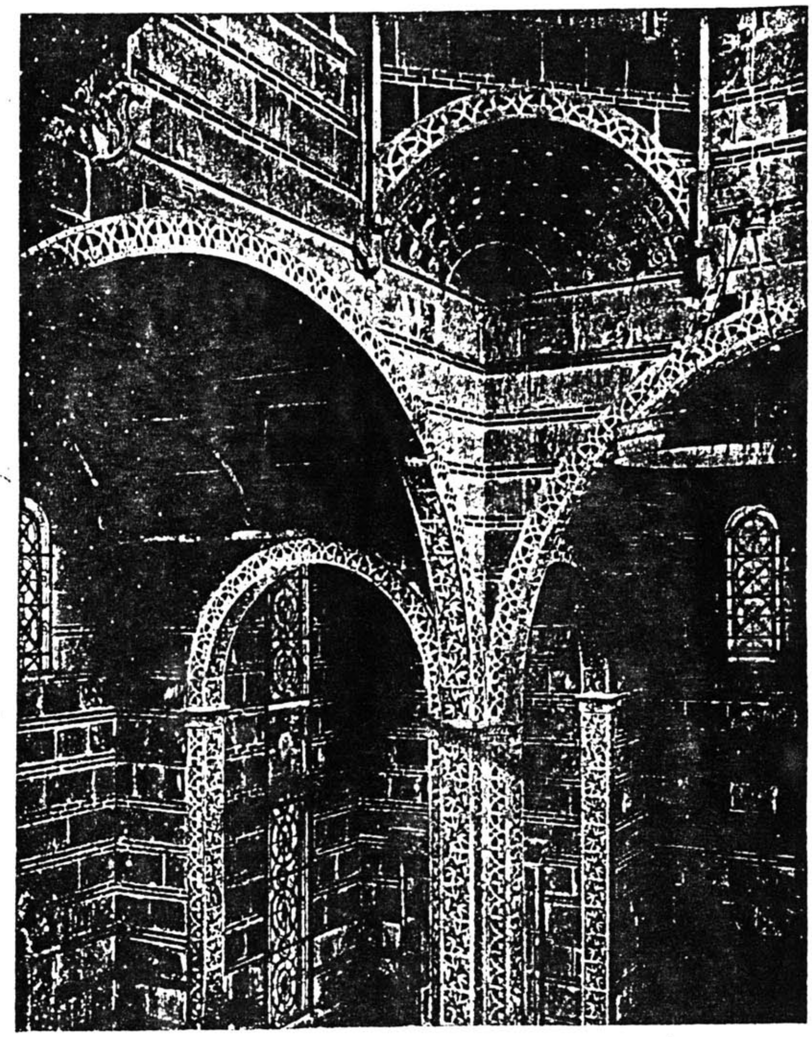

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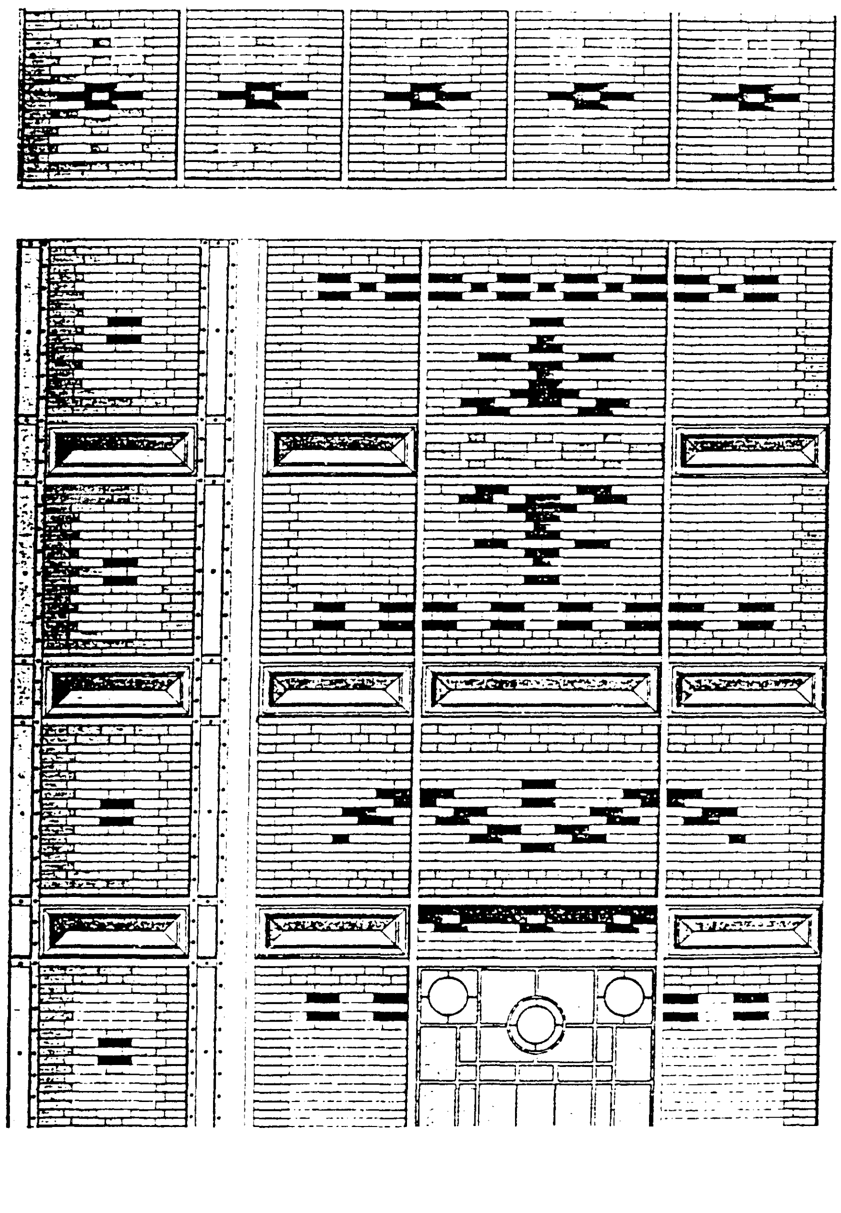
Source: La construction moderne, series 2, vol.6 (1900), pl.68.



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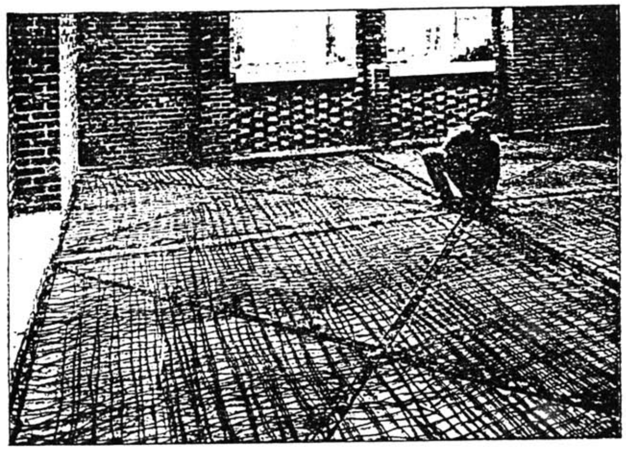
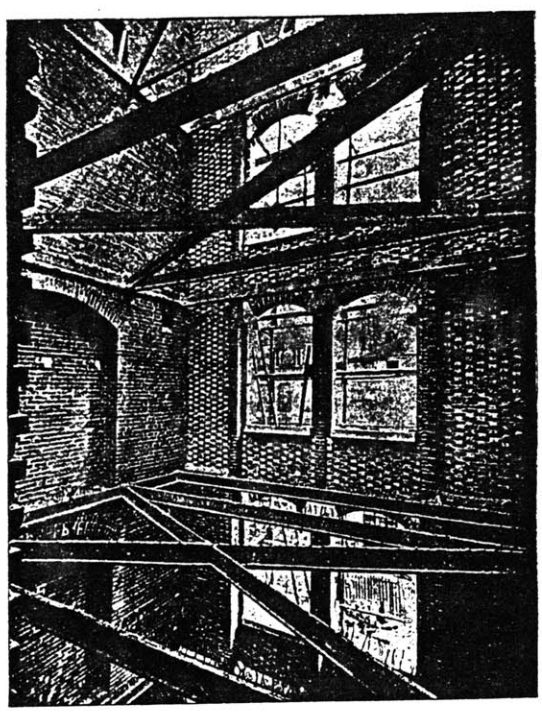
Source: Bernard Marrey, La brique à Paris, (Paris: Pavillon de l'Arsenal, 1993).





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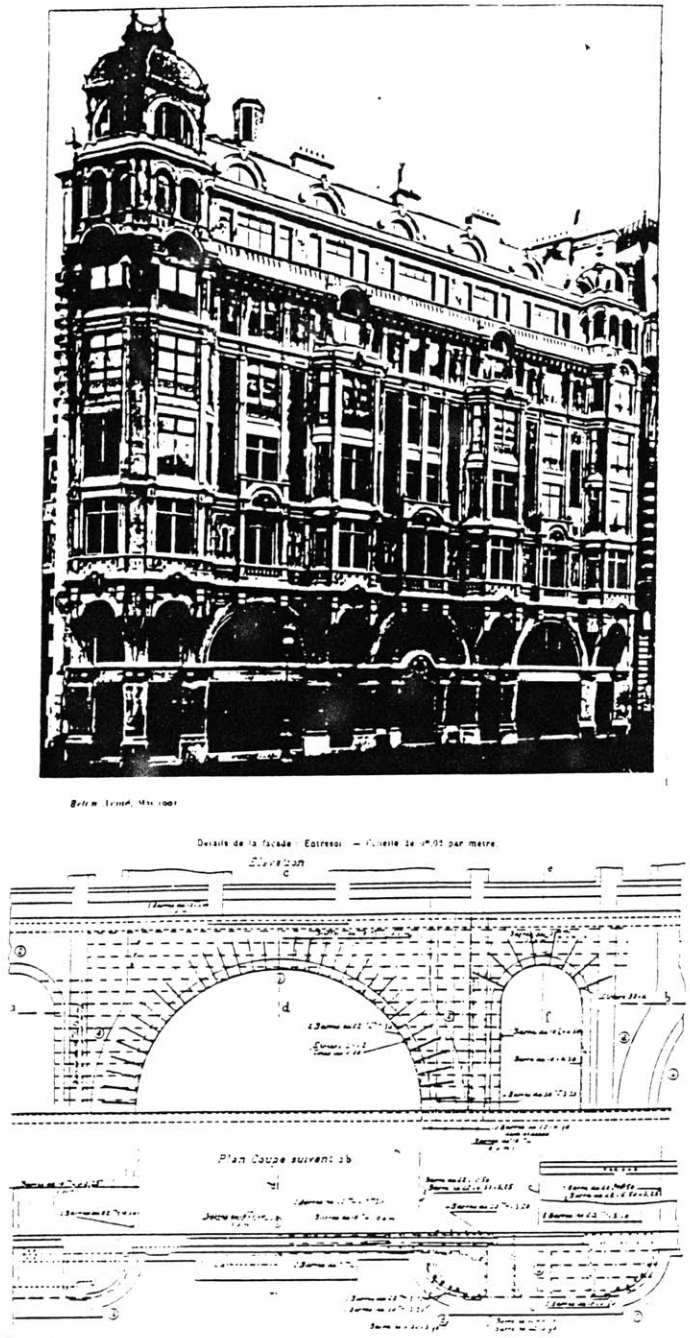

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Source: L'Art Decoratifs vol.5 (January-June 1903), p.171.

Fig.18. Henri Sauvage
Low-cost housing, rue Trétaigne, 1903
Source: The Architectural Drawings of Henri Sauvage, vol.1 (New York: Garland Architectural Archives, 1994), p.274.

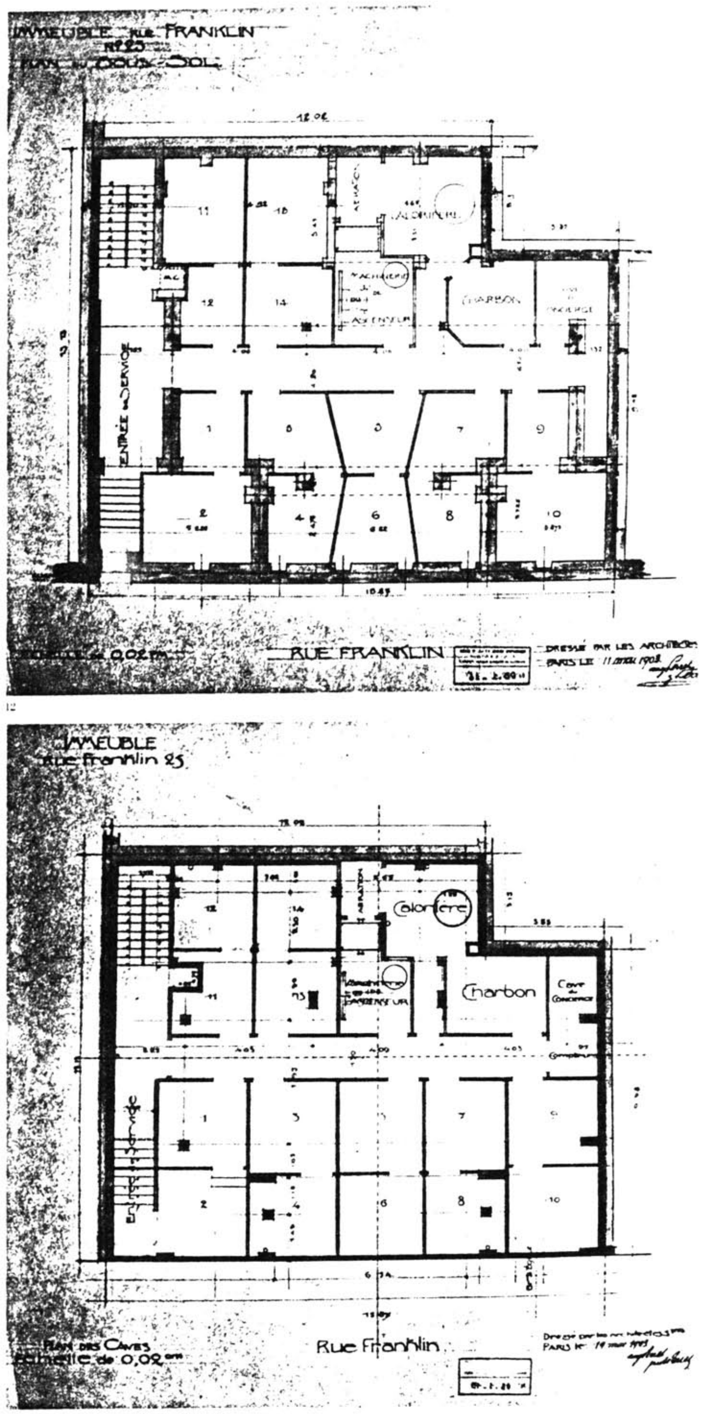


Fig.19. Auguste and Gustave Perret
25bis rue Franklin: basement plan, 1903
Source: Fonds Perret, in Rassegna no.28 (1986), p.24.

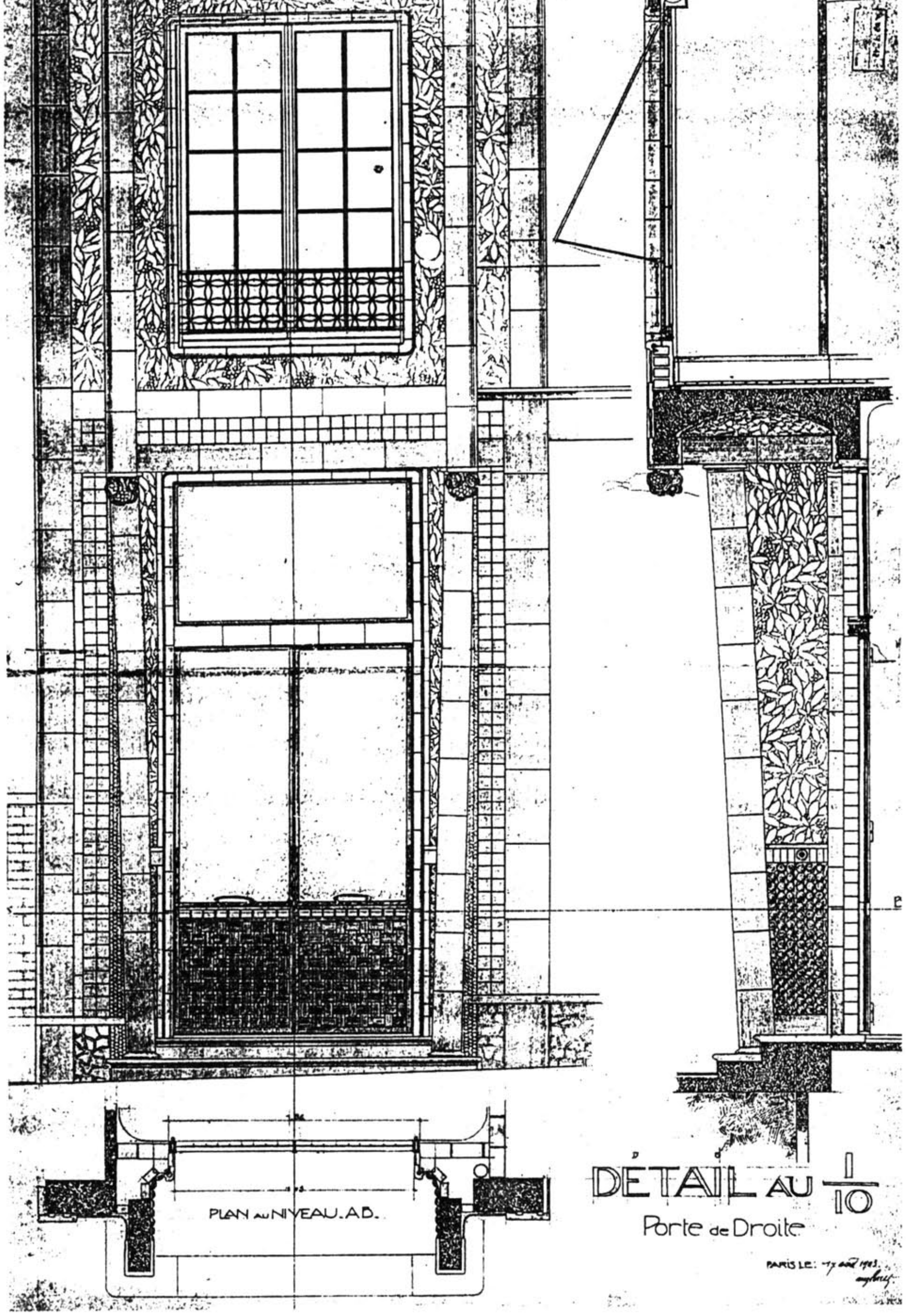


Fig.20. Auguste and Gustave Perret
25bis rue Franklin: details of structure and revetment,
1903
Source: Fonds Perret, in Rassegna no.28 (1986), p.2.

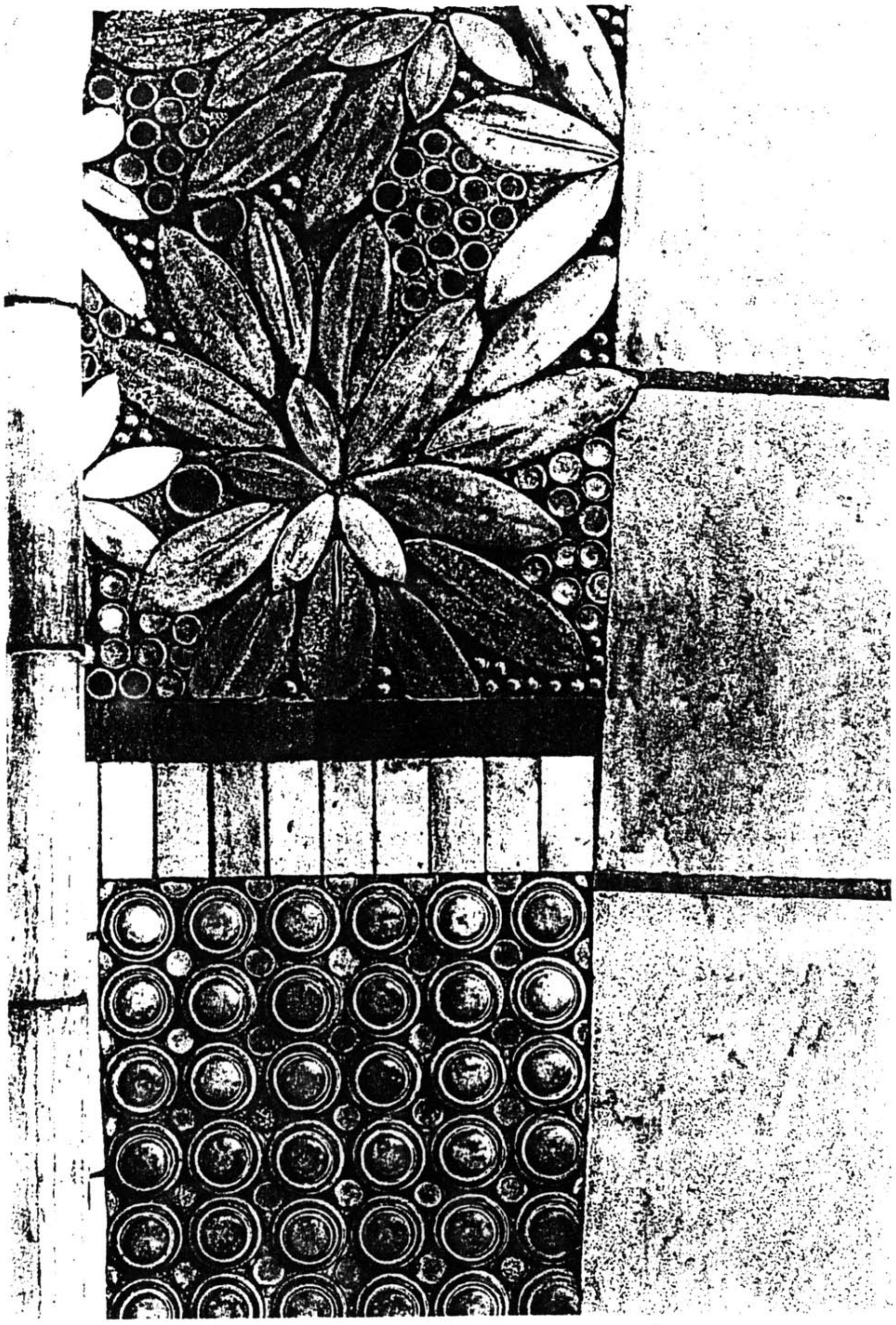


Fig.21. Auguste and Gustave Perret
25bis rue Franklin: details of the stoneware pastilles,
1903
Source: Roberto Gargiani, Auguste Perret. 1874-1954. Teoria e opere, (Milan: Electa, 1993), p.185.

Fig.22. Paul Guadet
Hôtel Carnot rue Elysée-Reclus, 1906-08
Source: Fonds Perret

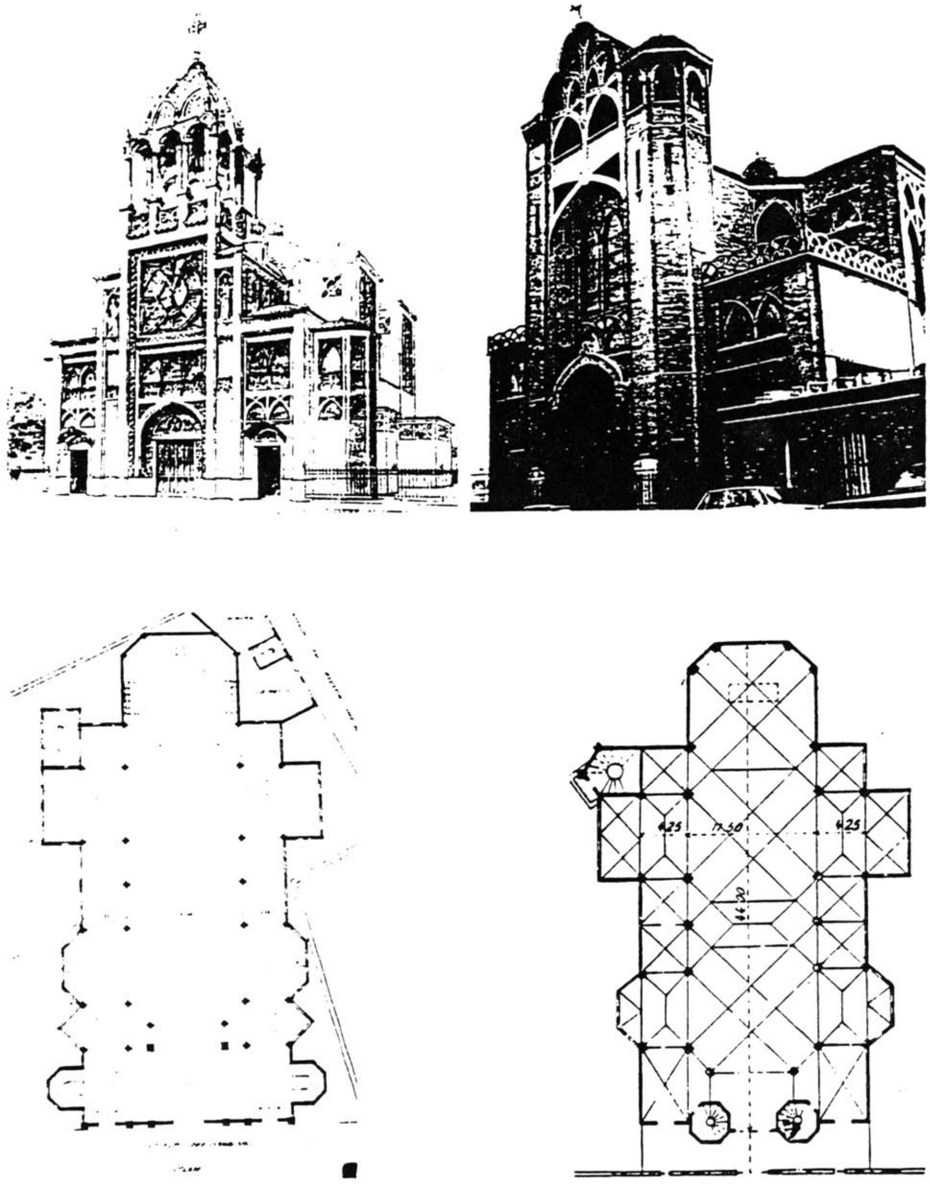


Fig.23. Anatole de Baudot
Saint-Jean-de-Montmartre Church: views and plans, 1896-1904
Source: Francoise Boudon, "Recherche sur la pensée et l'oeuvre d''Anatole de Baudot, 1834-1915," <u>AMC</u> no.28 (March 1973), p.42.

Fig.24. Anatole de Baudot
Saint-Jean-de-Montmartre church: interior views, 1896-1904
Source: Boudon, p.44.

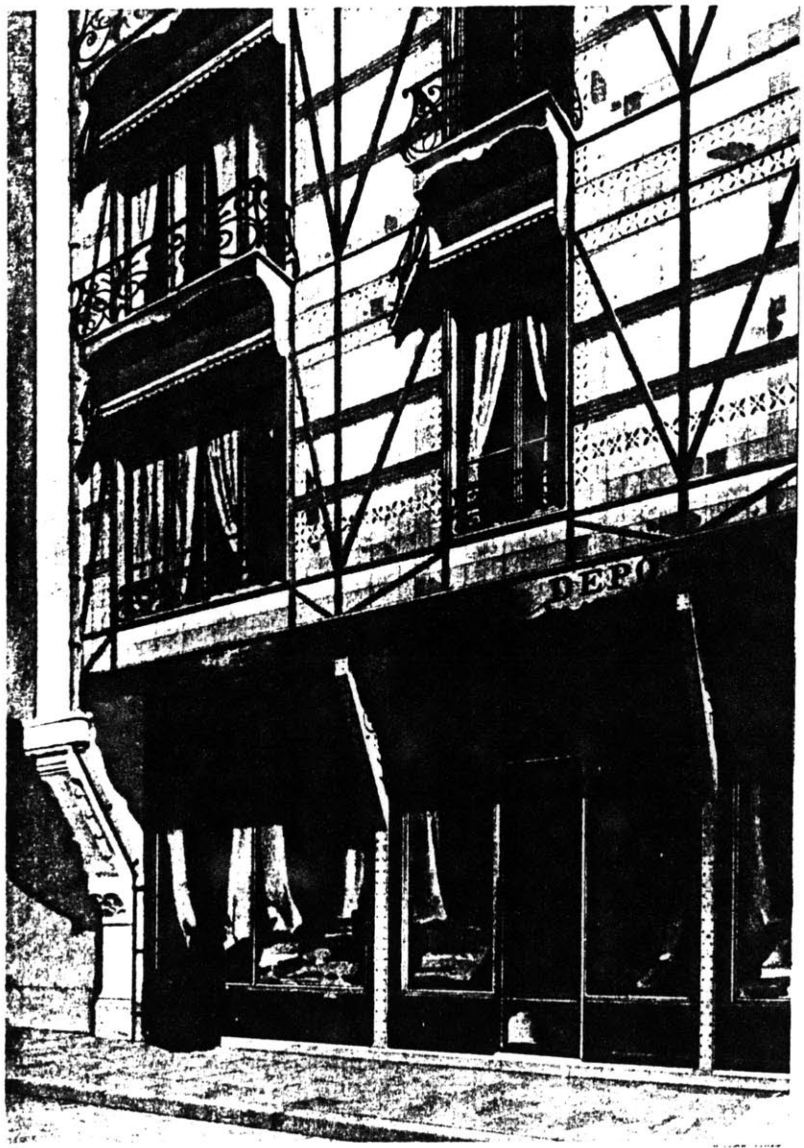
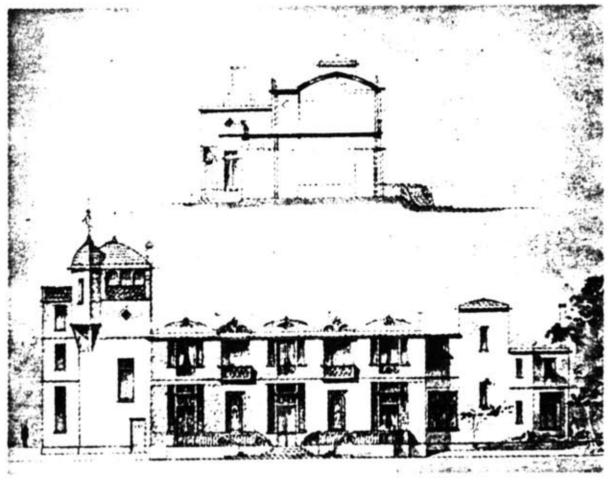


Fig.25. Eugène-Emmanuel Viollet-le-Duc
Iron-framed urban house, 1865
Source: Viollet-le-Duc, Entrentions, vol.2 (1872), pl.XXXVI.



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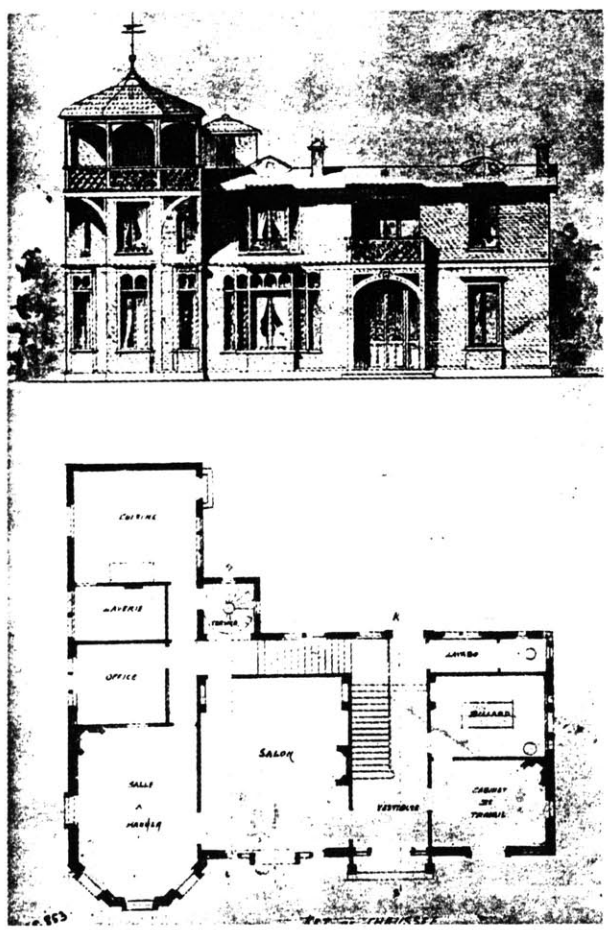


Fig.26. Anatole de Baudot
Two projects for low-cost housing: section and elevation; elevation and plan, 1908
Source: Fonds A. de Baudot, in Rassegna no.49 (1992), p.38.

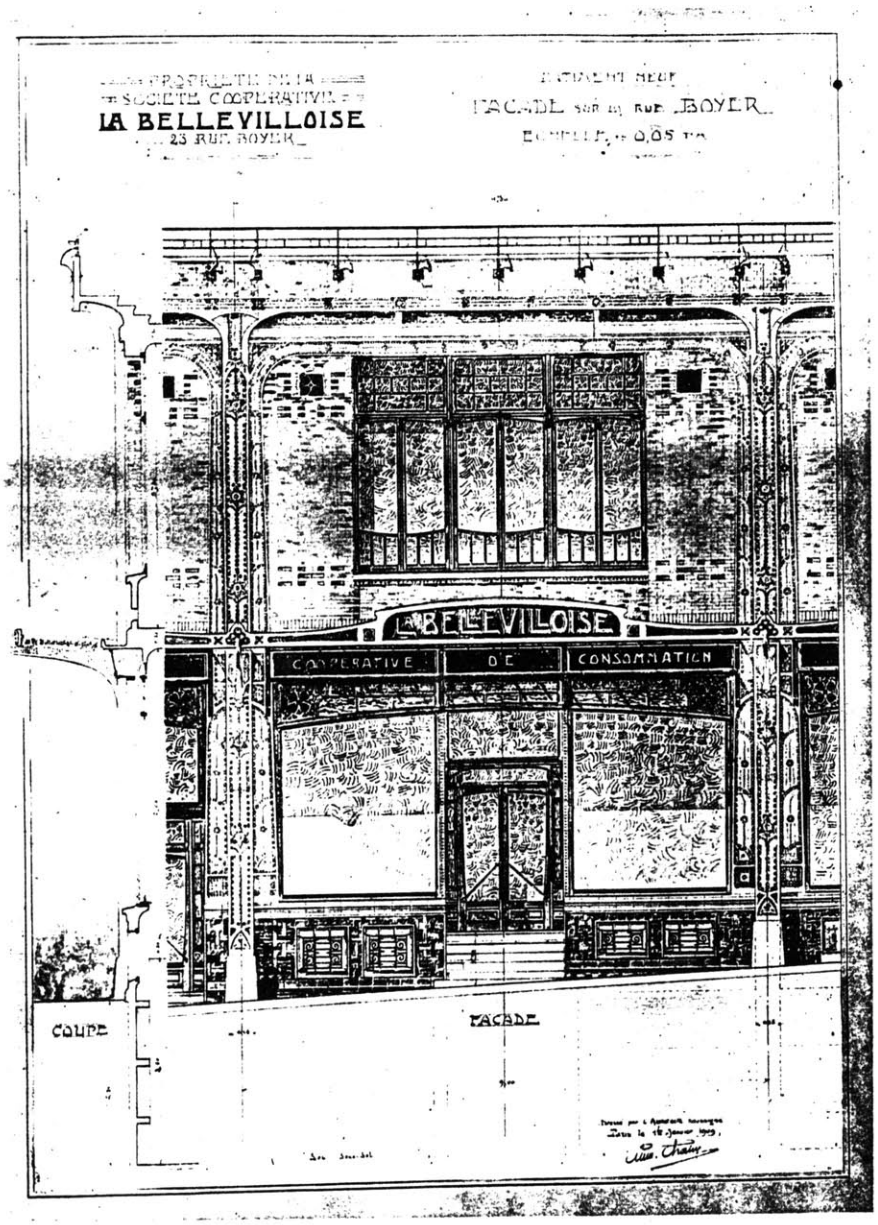


Fig.27. Emile Chaine
Project for the People's house "La Bellevilloise", 1908.
Source: Fond USAF, IFA, in Rassegna no.49 (1992), p.41.

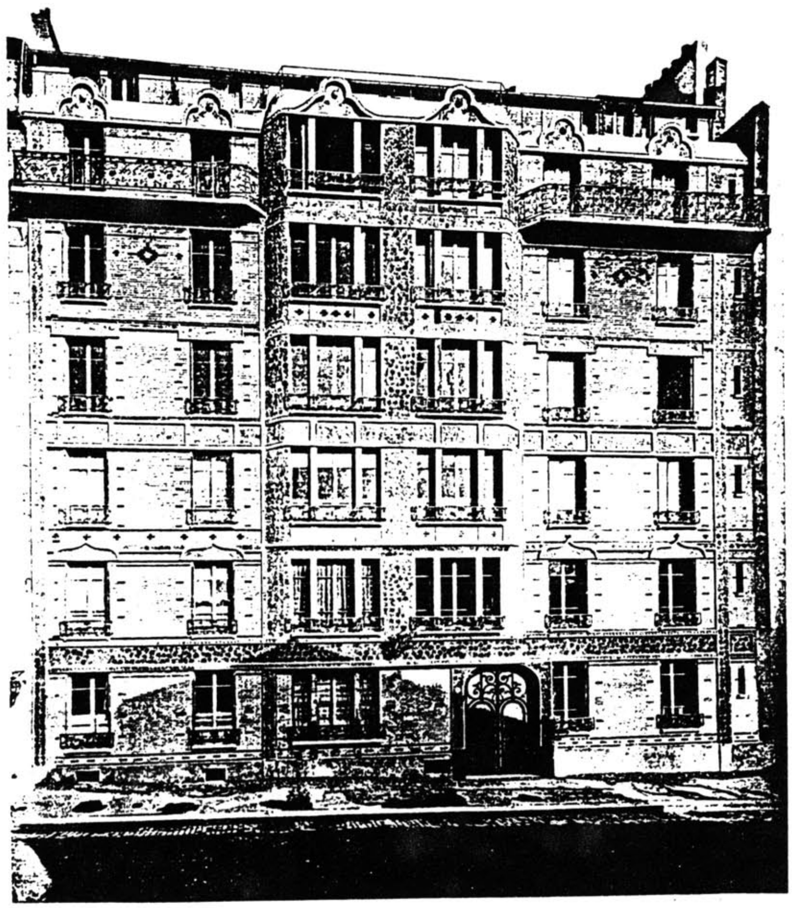
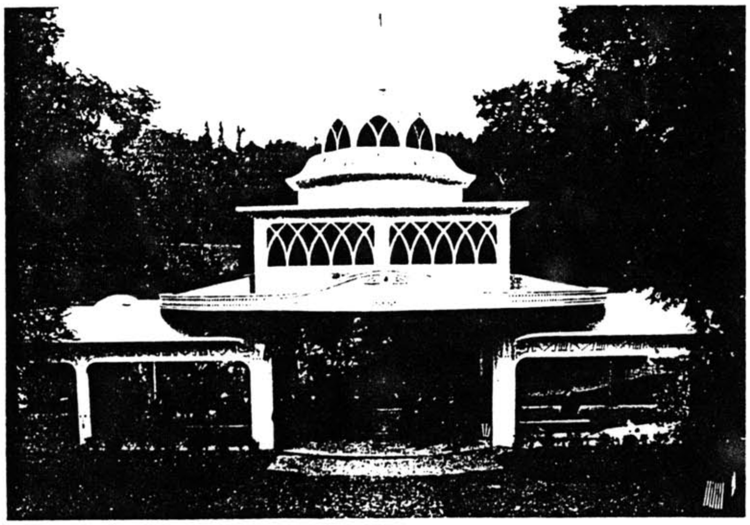


Fig.28. Joachim Richard
Residential building, rue Perrichont, 1907-1908
Source: L'Architecture Moderne vol.4, no.10 (October 1912), 301.



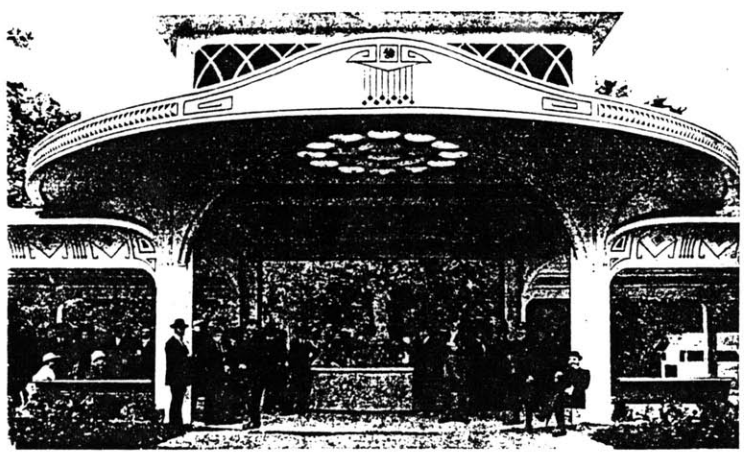


Fig.29. Joachim Richard
Buvette de l'Establissement thermal de Miers, 1911
Source: L'Architecture Moderne vol.4, no.10 (October 1912), p.310.

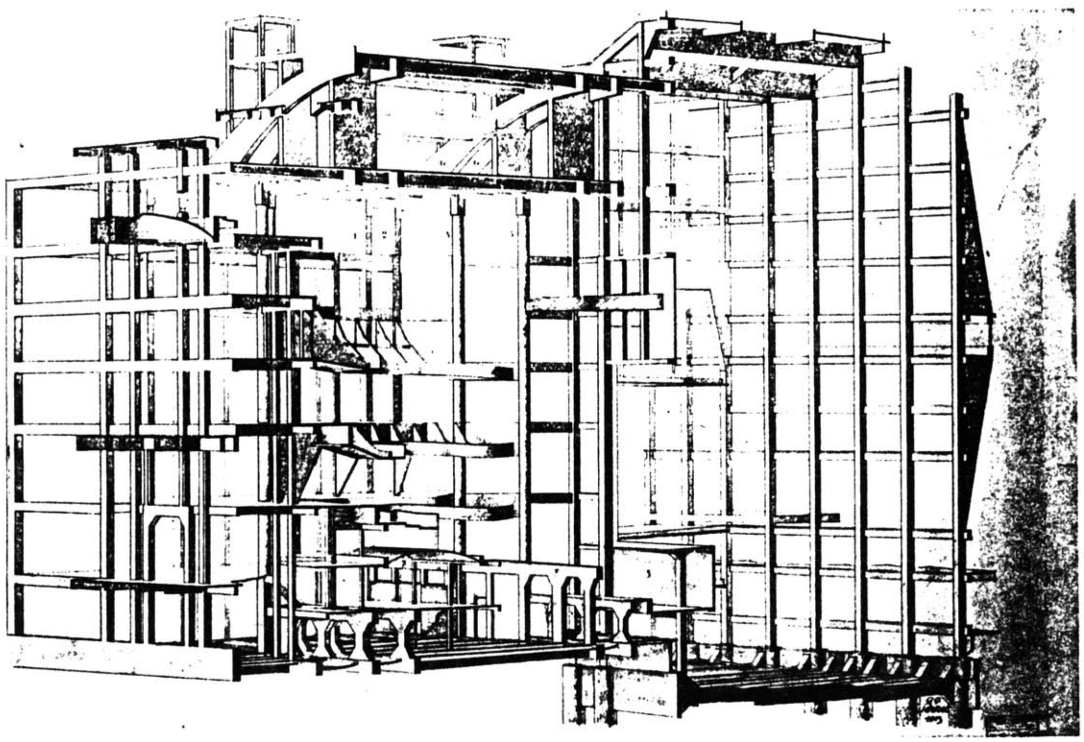


Fig.30. Auguste and Gustave Perret
Champs-Elysées Theater: axonometric for skeleton, 1913
Source: Fonds Perret, in Gargiani, Auguste Perret. 1874-1954. Teoria e opere, p.135.

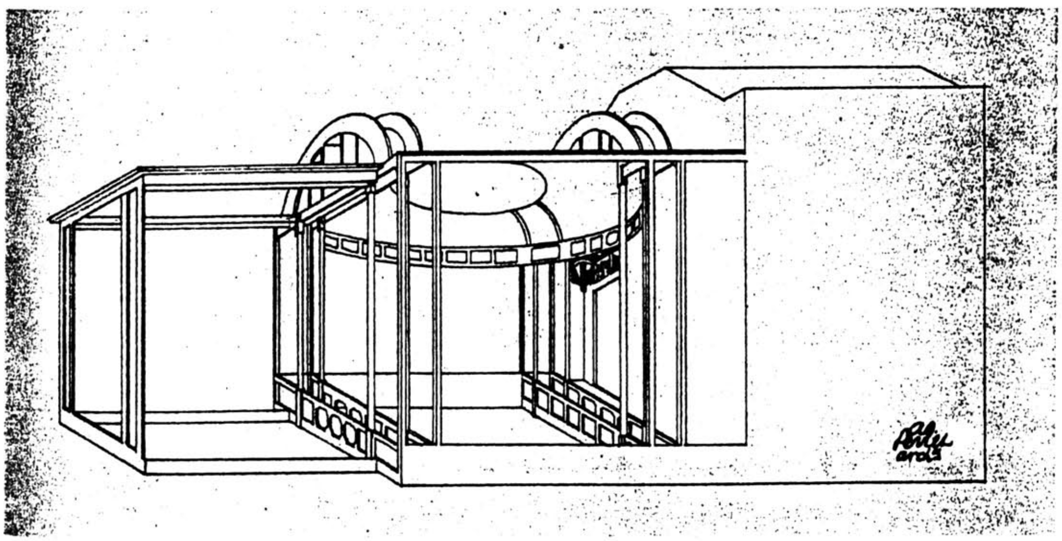


Fig.31. Auguste and Gustave Perret
Champs-Elysées Theater: perspective for the structural skeleton, 1913
Source: Fonds Perret, in Gargiani, Auguste Perret. 1874-1954. Teoria e opere, p.135.

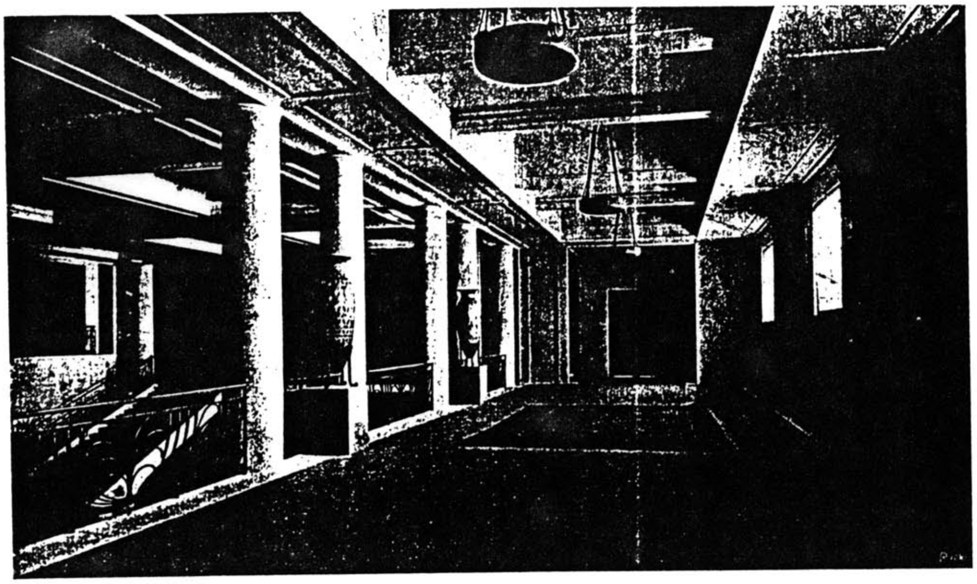


FIG. 75. — THÉATRE DES CHAMPS-ELYSÉES. Promenoir au niveau des grandes loges de la salle de musique. *A.* et *G. Perret*, architectes.

Plus loin :

« Lorsqu'une fois vous avez saisi la structure d'un édifice antique, sa forme, son expression, sa réalisation évoquent chez vous l'idée invincible du *nécessaire*. Cela devait être ainsi, cela ne pouvait pas n'être pas ainsi. Et en même temps, c'est généralement d'une grande beauté : mais beauté de par la composition, et non beauté de par l'artifice. Voilà l'art parfait.

« Mais est-ce le privilège de l'antiquité ? Non. Cette même sincérité, cette même identité, cette impression du « *cela ne pouvait n'être pas ainsi* », je la retrouve dans les premières basiliques, dans nos églises des XII^e^, XIII^e^, XIV^e^ siècles, dans nos hôtels de ville du nord, dans les palais de la Renaissance italienne, dans nos beaux édifices modernes...

« Tel est le vrai but, le but élevé de notre art.

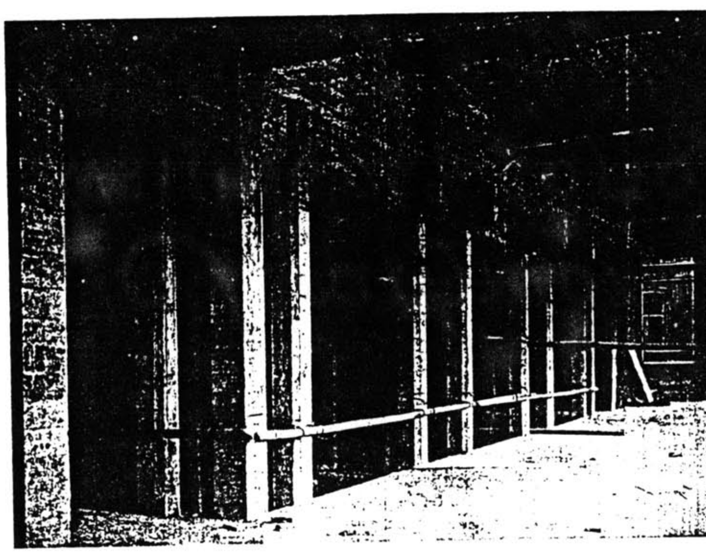


FIG. 76. — THÉATRE DES CHAMPS-ELYSÉES. Structure du promenoir des grandes loges. — *A.* et *G. Perret*, architectes.

Fig.32. Auguste and Gustave Perret
Champs-Elysées Theater: views of mezzanine level showing internal reinforced-concrete posts, 1913
Source: Paul Guadet, "Le Théâtre des Champs-Elysées," <u>L'Architecte</u> vol.8 (November 1913), 85.

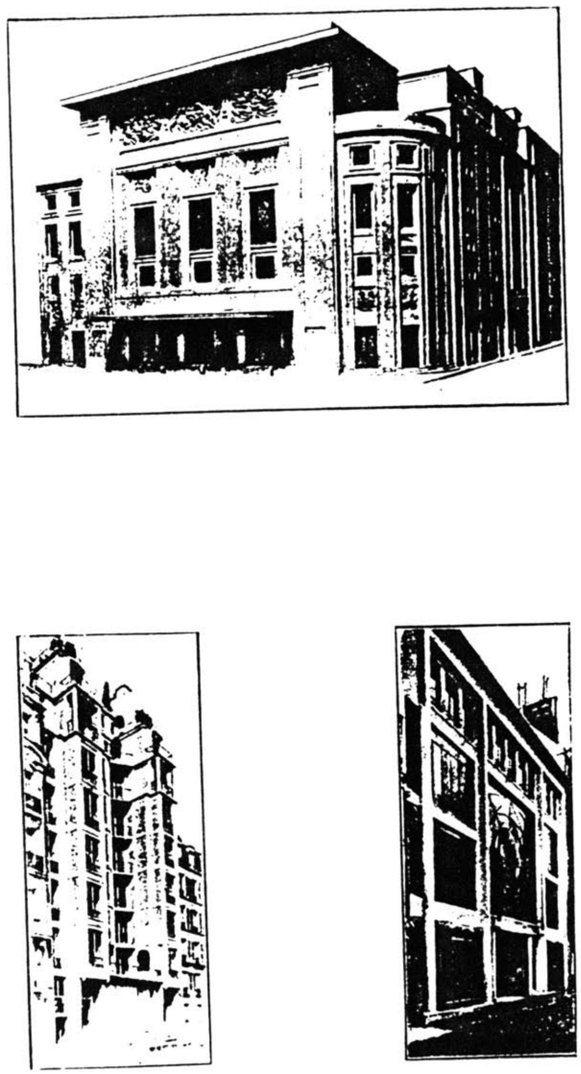
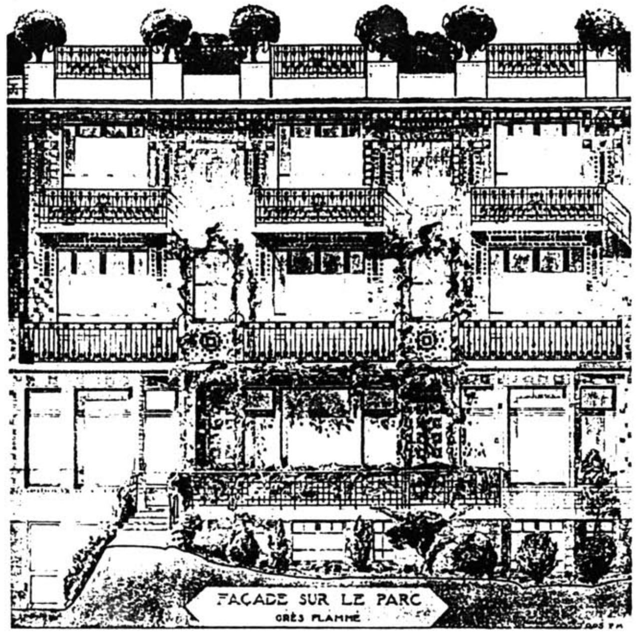


Fig.33. Auguste and Gustave Perret
Views of three projects, 1903-1913
Source: Pascal Forthuny, Les Cahiers de l'Art Moderne
no.7 (30 October 1913), pl.IV.



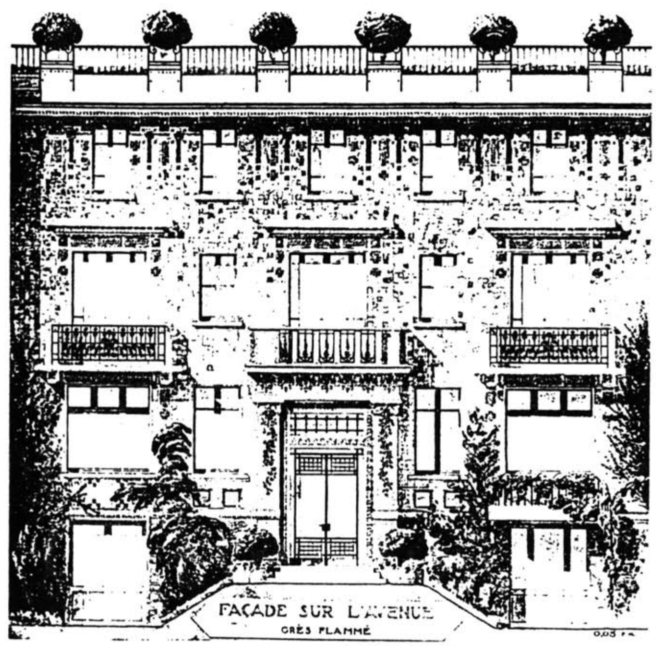


Fig.34. Paul Guadet
Hôtel Carnot rue Elysée-Reclus: details of the façade decoration, 1908.
Source: Fonds Guadet

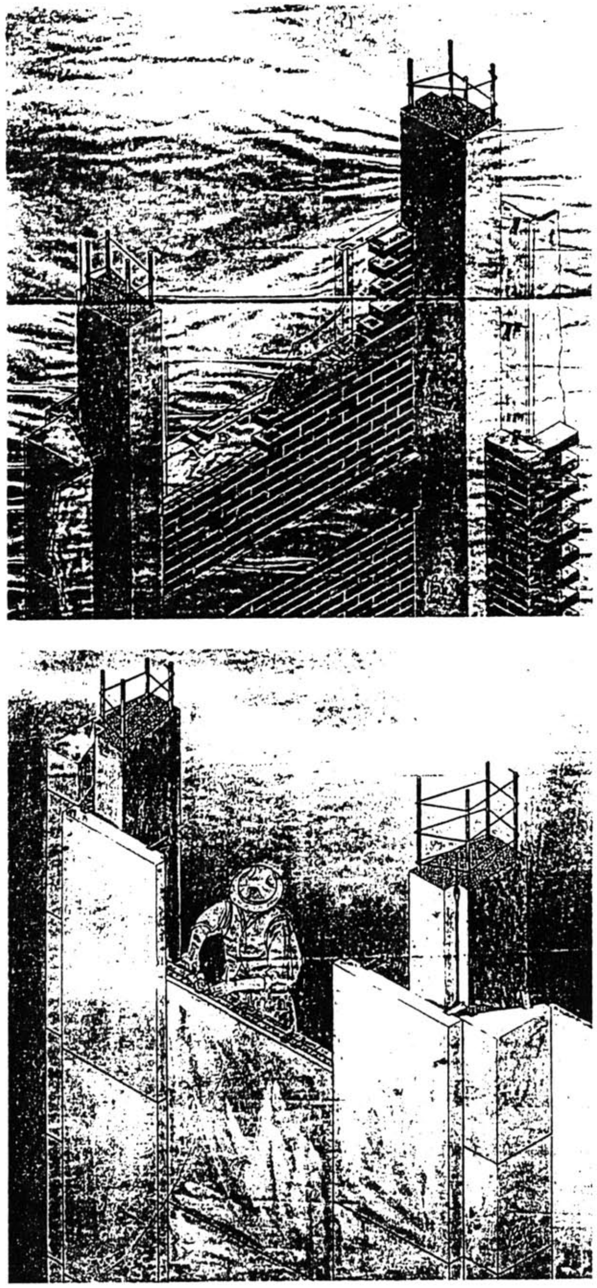
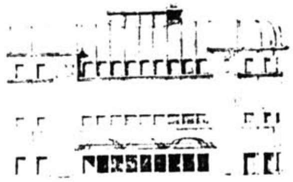
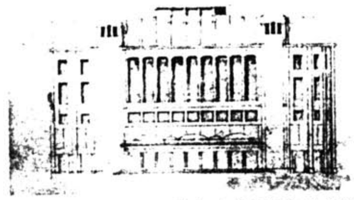


Fig.35. Auguste and Gustave Perret
Champs-Elysées Theater: axonometrics for the application of the revetment, 1913.
Source: Fonds Perret

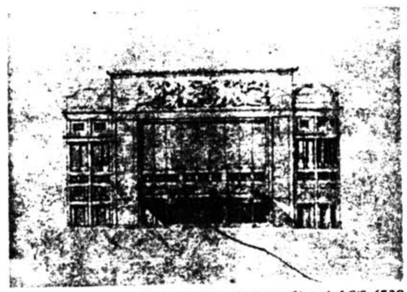


Etude de façade 3, s.d. LC/S 4534

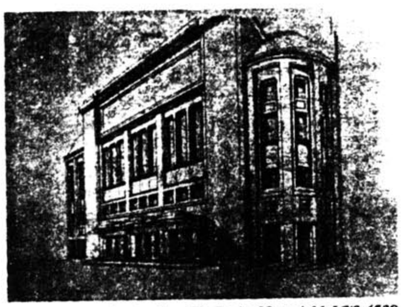


Etude de façade 4, s.d. LC/S 4535

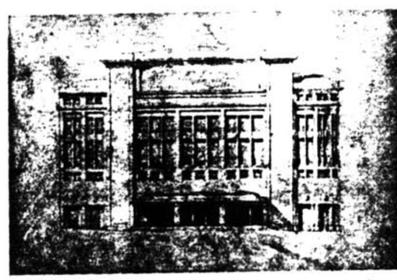
Etude de façade 5, 19 mai 11, v.d.V. LC/S 4536



Etude de façade (var. 6), s.d. LC/S 4538



Perspective (7), Paris, 22 mai 11. LC/S 4539



Etude de façade 8, s.d. LC/S 4541

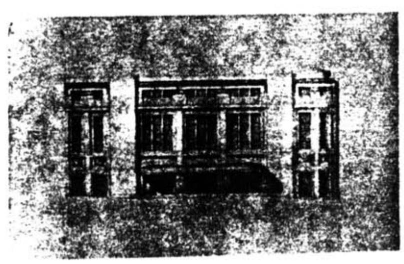


Fig.36. Henry Van de Velde
Champs-Elysées Theater: elevation studies for the façade,
1911
Source: La Cambre Archives, in Léon Ploegaerts and
Pieree Puttemans, L'Oeuvre Architecturale de Henry van de
Velde, (Bruxelles-Québec: Atelier Vokaer-Université
Laval, 1987), p.322.

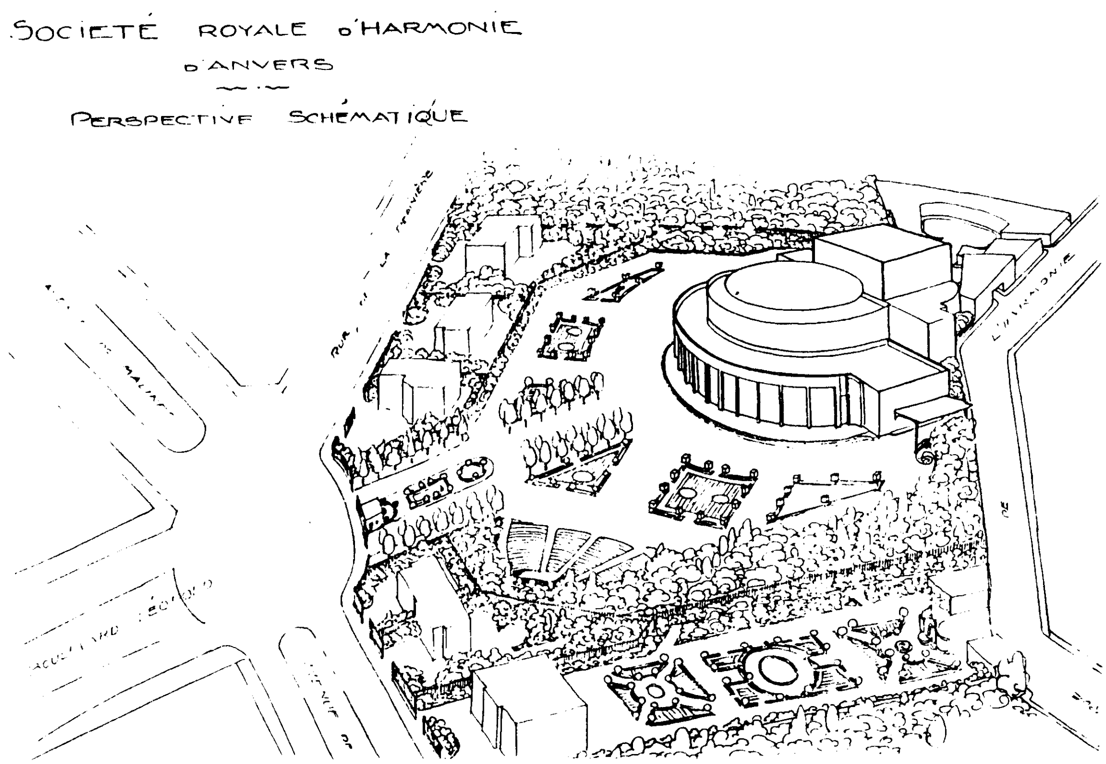


Fig.37. Auguste and Gustave Perret
Théatre de l'harmonie, Anvers: bird's-eye view, 1914
Source: Fonds Perret

Fig.38. André Mare and Raymond Duchamps-Villon
Maison cubiste, 1912
Source: Nancy Troy, Modernism and the Decorative Arts in France: Art Nouvea to Le Corbusier, (New Haven and London: Yale University Press, 1991), p.81.

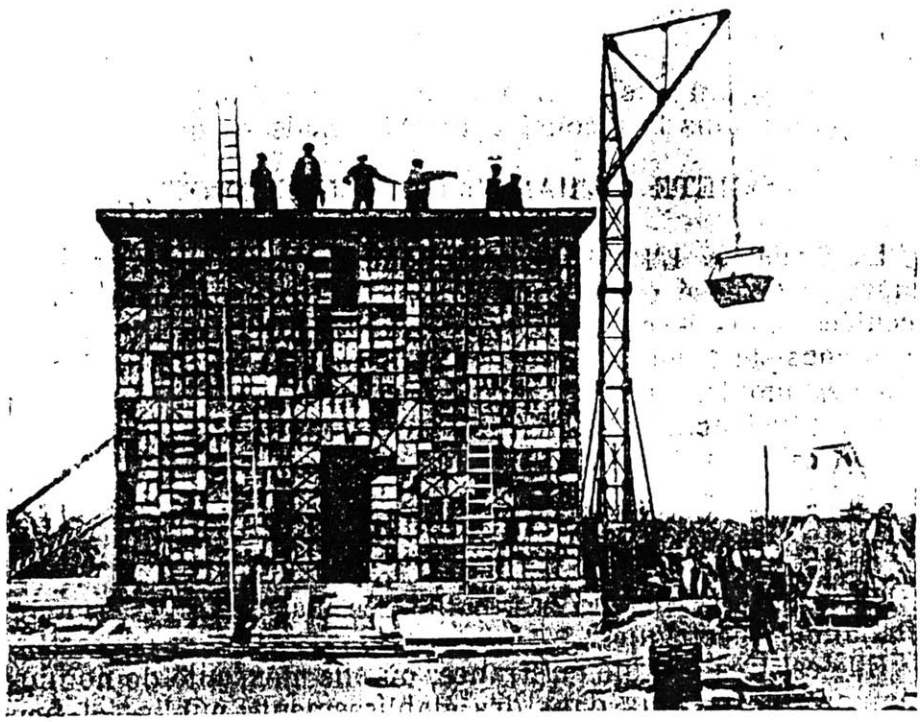
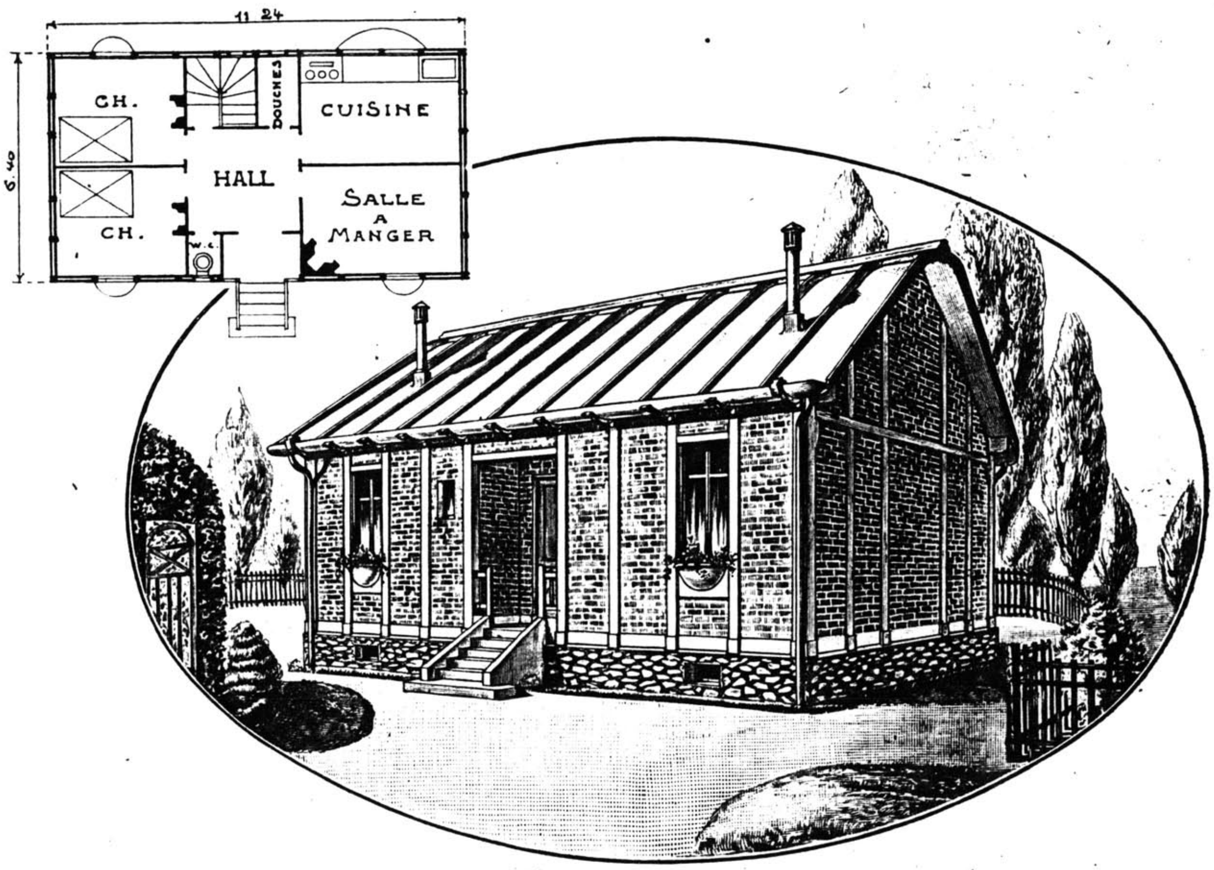


Fig.39. Unknown architect
Société Française des maisons et constructions moulées, 1916.
Source: Louis Gaultier, Exposition de la Cité reconstituée. Rapport Général, (Paris, 1917), p.103.



Exemple n° 5. -- Maison à 1 logement – 10 travées – 11 m. 24 x 6 m. 40

Fig.40. Bessoneau and Charles-Henri Besnard
Prefabricated house in reinforced concrete: perspective and plan, 1919
Source: Les constructions Bessoneau, (Paris: 15 April 1919), n.p.

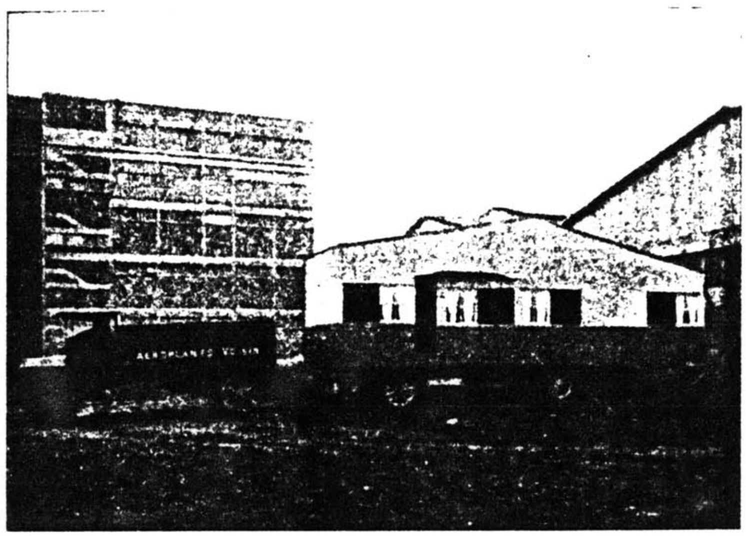


Fig.41. Gabriel Voisin
Prefabricated houses, 1919
Source: Le Corbusier-Saugnier, "Les Maisons Voisin,"
L'Esprit Nouveau (November 1920), p.211.

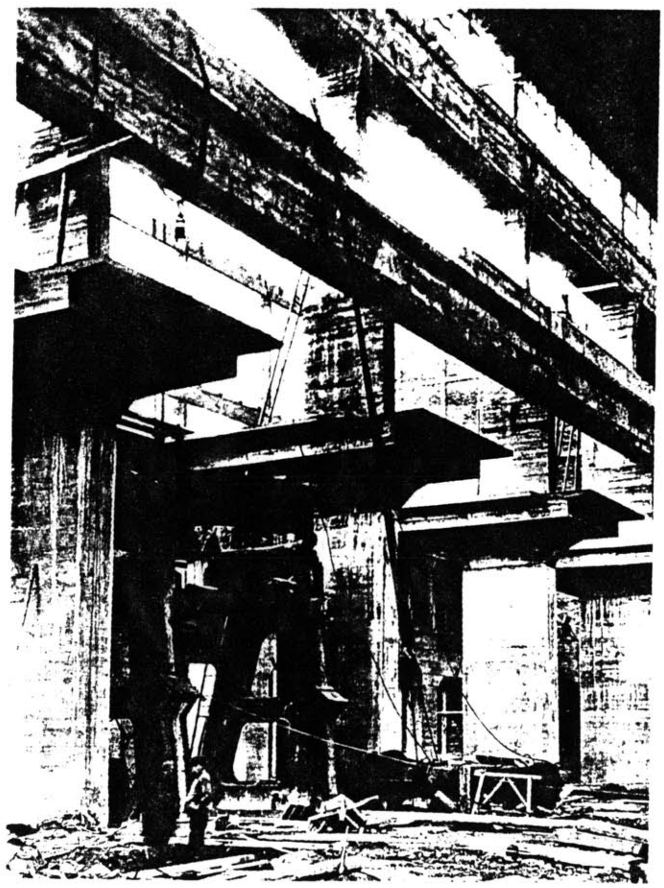


Fig.42. Freyssinet and Limousin
Steelworks, Caen, 1918
Source: Art et Décoration (July-August 1919), in Rassegna no.49 (1992), p.59

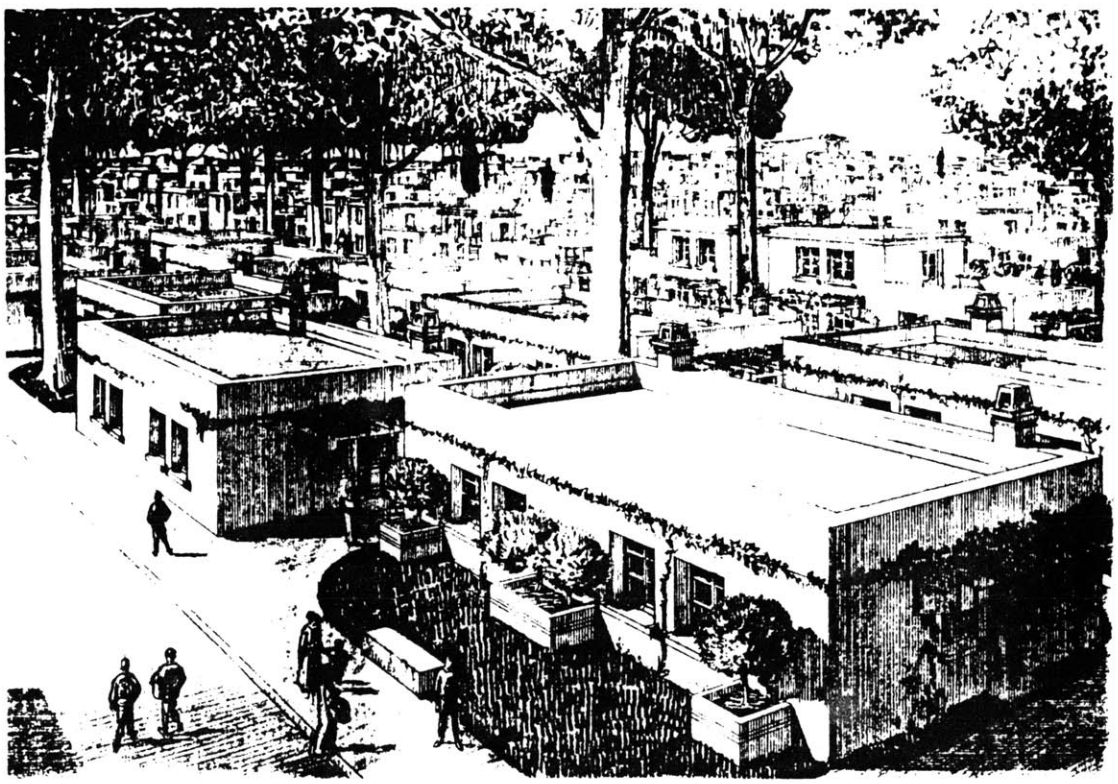


Fig.43. Tony Garnier
Une Cité industrielle: perspective for housing, 1917.
Source: Garnier, Une Cité Industrielle: Etudes pour la construction des villes, (reprint, Paris: Philippe Sers, 1988), pl.82

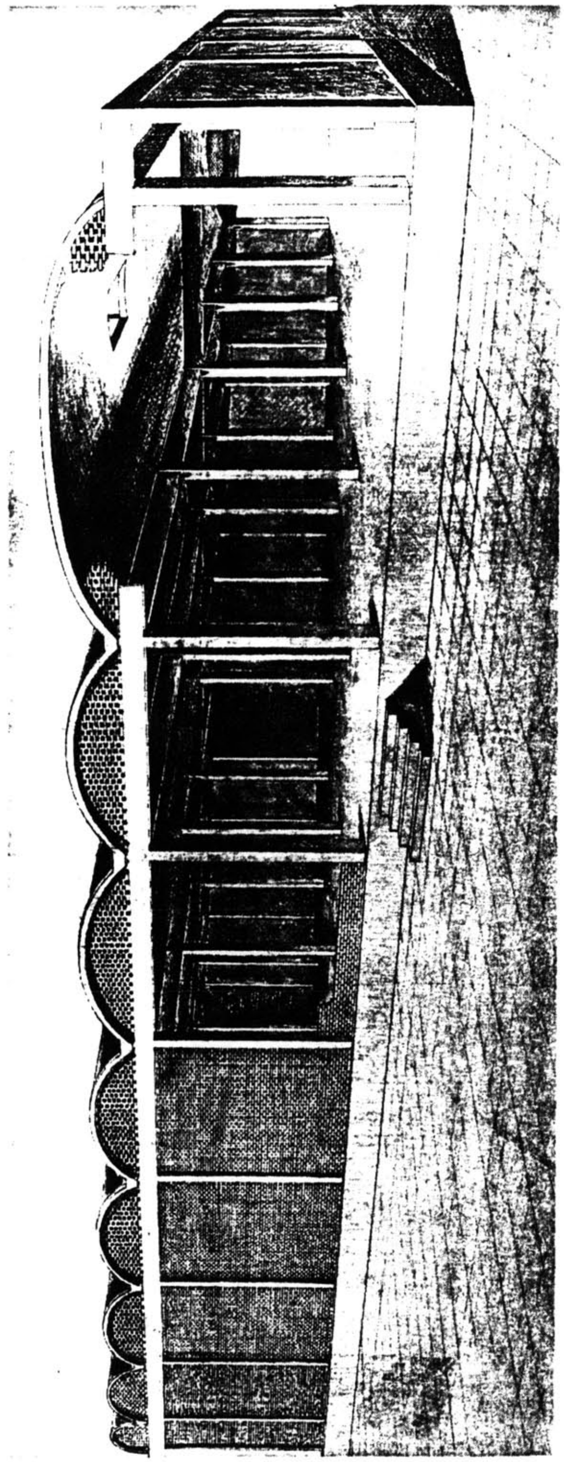


Fig.44. Auguste and Gustave Perret
Wallut warehouses, Casablanca: perspective, 1914-1916
Source: Fonds Perret

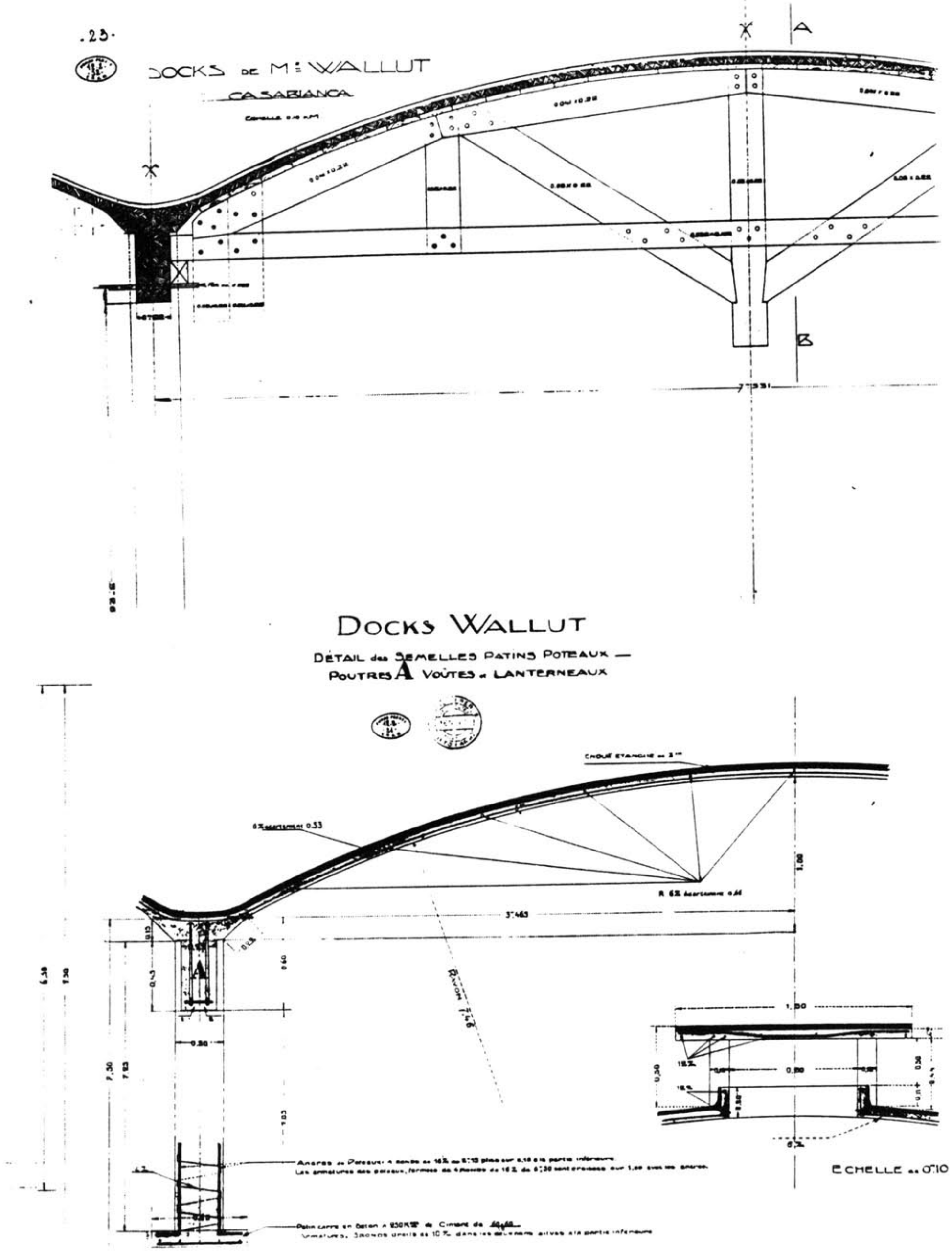


Fig.45. Auguste and Gustave Perret
Wallut warehouses, Casablanca: working drawing for reinforced-concrete vaults, 1916
Source: Fonds Perret

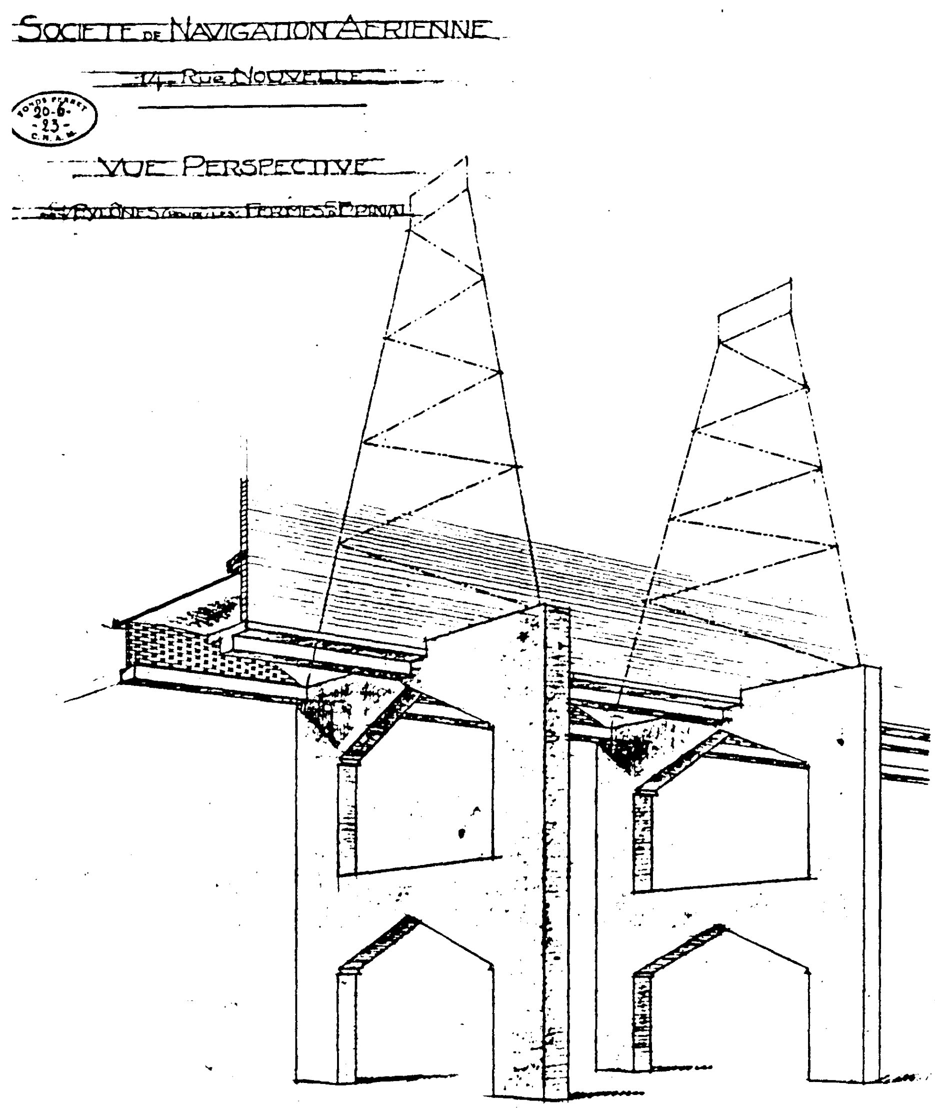


Fig.46. Auguste Perret and Louis Gellusseau
Airship shed for the Service de la navigation aérienne: perspective study for structural pylons, 1917
Source: Fonds Perret

Fig.47. Auguste and Gustave Perret
L'ateliers Esders: interior view showing low-vaulted floors, 1919.
Source: Fonds Perret

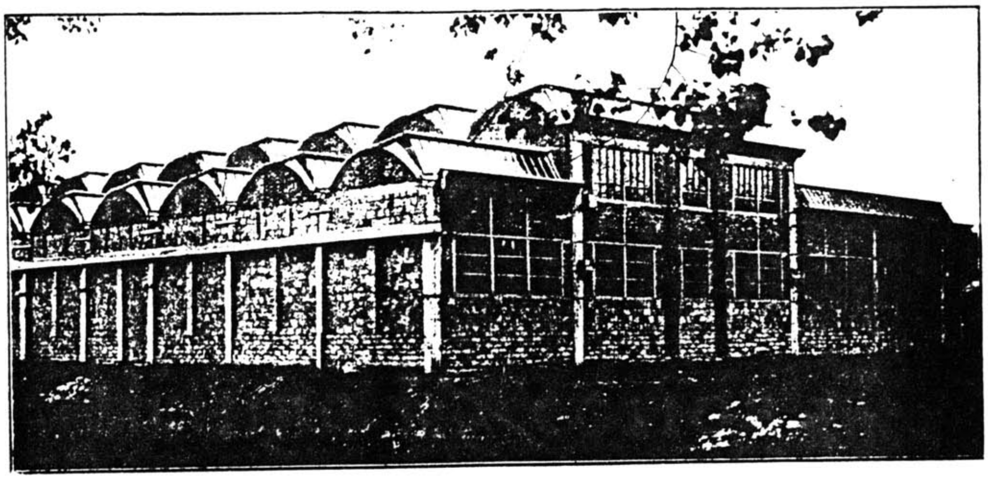


Fig.48. Auguste and Gustave Perret
L'atelier Marinoni: exterior view and interior view showing parabolic vaults, 1920-1921.
Source: Le Constructeur de ciment armé vol.4, no.29 (February 1922), p.33.

COUVERTURE EN SHEDS DES ATELIERS J. VOIRIN, A MONTATAIRE

Ce mode original de couverture en sheds est une heu-

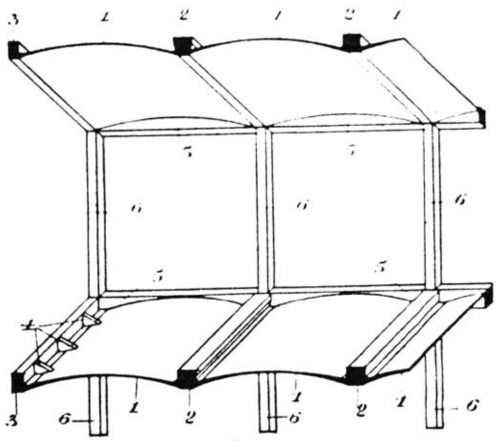


Fig. 1.

reuse application des planchers en voûtes légères breve-tées. En raison de leur faible montée par rapport à leur portée, on peut établir sur ces voûtes formant plafond un sol horizontal à l'aide de sable, de mâchefer, etc., étendus sur leur extrados, ou en frises de parquet posées sur des lambourdes reposant sur des murettes maçonnées

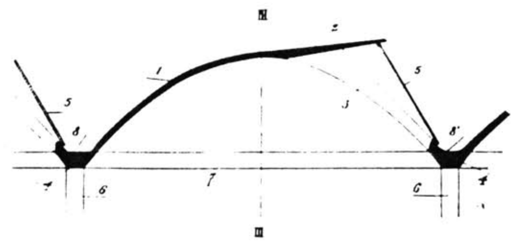


Fig. 3.

à l'écartement convenable sur lesdits extrados. Les naissances de ces voûtes trouvent leur appui sur des nervures supérieures, entretoisant les poteaux et prévues pour équilibrer les poussées élémentaires : quant aux poussées totales elles sont équilibrées par des tirants non apparents

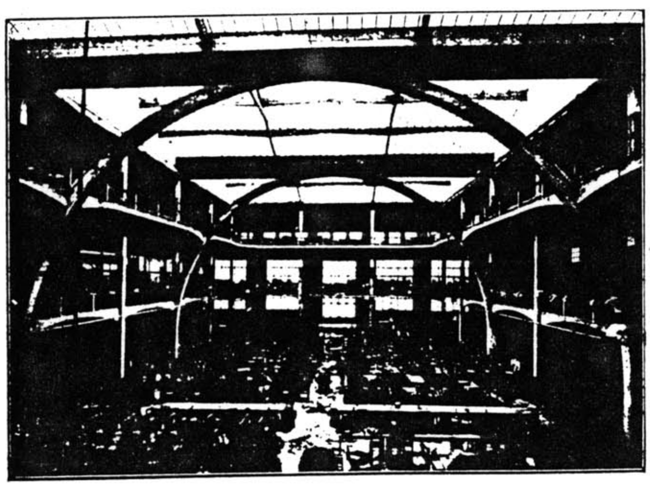


Fig. 2. — Planchers en voûte. (Ateliers Esders.)

Fig.49. Auguste and Gustave Perret
Patent:"Perfectionnement apportés à l'établissement des planchers et des toitures en ciment armé": diagrams and view of L'atelier Esders, 1920.
Source: Le Constructeur de ciment armé vol.4, no.29 (February 1922), p.32

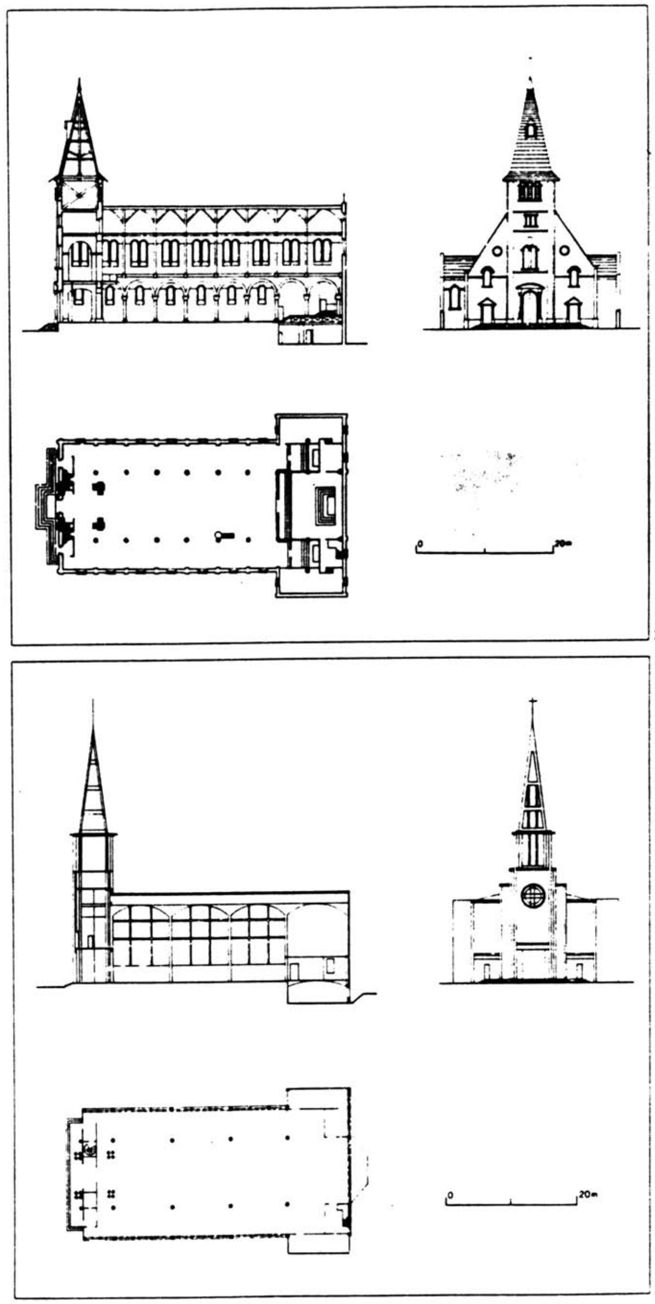
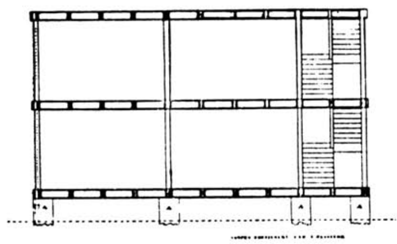
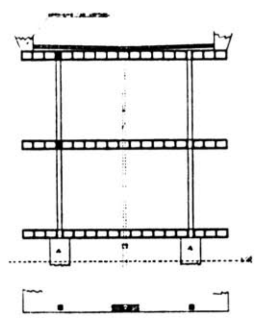
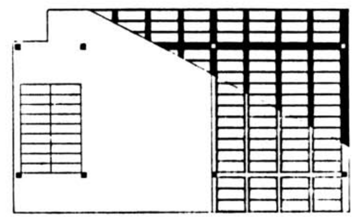


Fig.50. A. Guyot and Auguste and Gustave Perret
Two projects for Notre-Dame du Raincy: elevations, sections, and plans, 1922 (upper: Guyot; lower: August and Gustave Perret)
Source: Andrew Saint, Masters of Building, Architects' Journal vol.7 (13 February 1991), p.29.

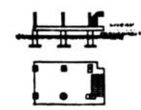




Coupes verticales sur l'ossature



Coupe sur le plafond

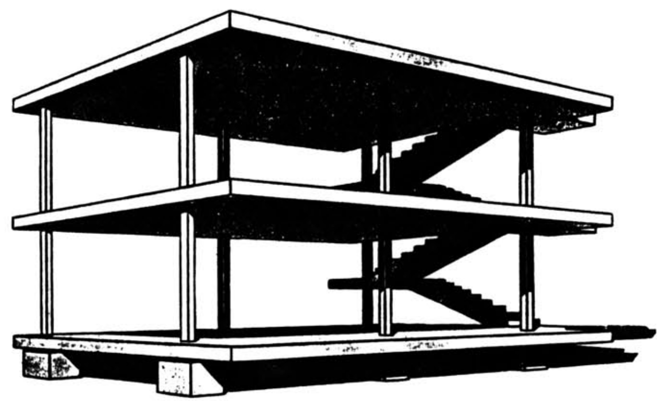


Les fondements

LES MAISONS «DOM-INO» — L'intuition agit par éclairs inattendus. Voici en 1914 la conception pure et totale de tout un système de construire, envisageant tous les problèmes qui vont naître a la suite de la guerre et que le moment présent a mis à l'actualité. C'est quinze ans après seulement, en 1929 et à l'occasion de la Loi Loucheur que Le Corbusier et Jeanneret peuvent appliquer intégralement les principes de la maison «Dom-ino». Il a fallu quinze années d'expérimentation, de mise au point localisée sur les divers détails du système, pour permettre d'atteindre à la réalisation.

Le problème posé était le suivant: les premières dévastations de la grande guerre dans les Flandres en septembre 1914. «La guerre devait durer trois mois seulement!» «On devait reconstruire les villages détruits en quelques mois aussi!» Le cauchemar serait ainsi vite oublié. (Tel état le bon sens public des gens au pouvoir auquel on aime tant à se référer!)

On a donc conçu un *système de structure* — ossature — *complètement indépendant des fonctions du plan de la maison:* cette ossature porte simplement les planchers et l'escalier. Elle est fabriquée en éléments standard, combinables les uns avec les autres, ce qui permet une grande diversité dans le groupement des maisons. Ce béton armé-là est fait sans coffrage; à vrai dire, il s'agit d'un matériel de chantier spécial qui permet de couler les planchers définitivement lisses dessus et dessous au moyen d'un très simple échafaudage de poutrelles double T accrochées temporairement à des colliers qui sont fixés au sommet de chaque poteau; les poteaux de béton sont coulés à pied d'œuvre et dressés avec le système de coffrage ci-dessus. Une société technique livre en tous endroits du pays, des ossatures orientées et groupées à la demande de l'architecte urbaniste ou, plus simplement du client.



L'ossature standard «Dom-ino», pour exécution en grande série

Il reste ensuite à installer une habitation à l'intérieur de ces ossatures. Le format de l'ossature «Dom-ino», la situation toute particulière des poteaux, permettent d'innombrables combinaisons de dispositions intérieures et toutes prises de lumière imaginables en façade. On avait conçu l'idée d'une Société, sœur de la première qui vendrait, elle, tous les éléments de l'équipement de la maison, c'est-à-dire, tout ce qui peut être fabriqué en usine

Fig.51. Le Corbusier
Maison Dom-ino: sections, plan, and perspective, 1914
Source: Le Corbusier and Pierre Jeanneret, Oeuvre Complète de 1910-1929, (Zürich: Editions Dr. H.Girsberger, 1943), p.23.

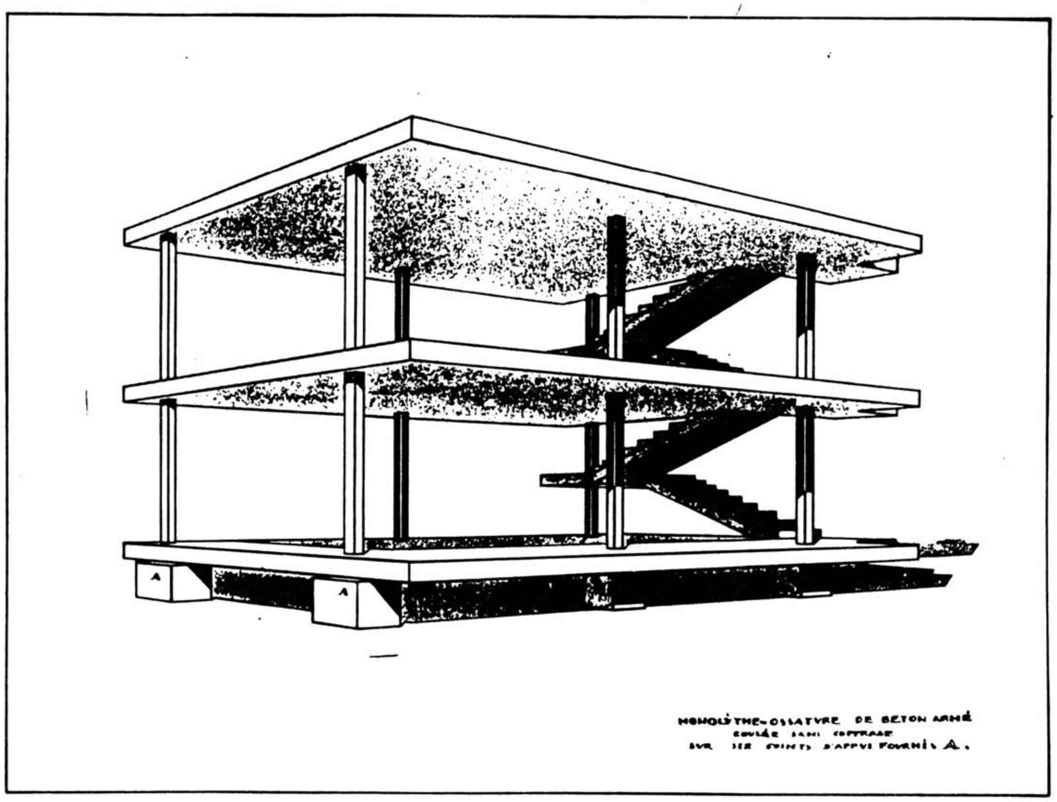


Fig.52. Le Corbusier
Maison Dom-ino: labelled perspective, 1914
Source: H. Allen Brooks, ed., The Le Corbusier Archive, vol.1 (New York-London-Paris: Garland Publishing and Fondation Le Corbusier, 1982), p.60.

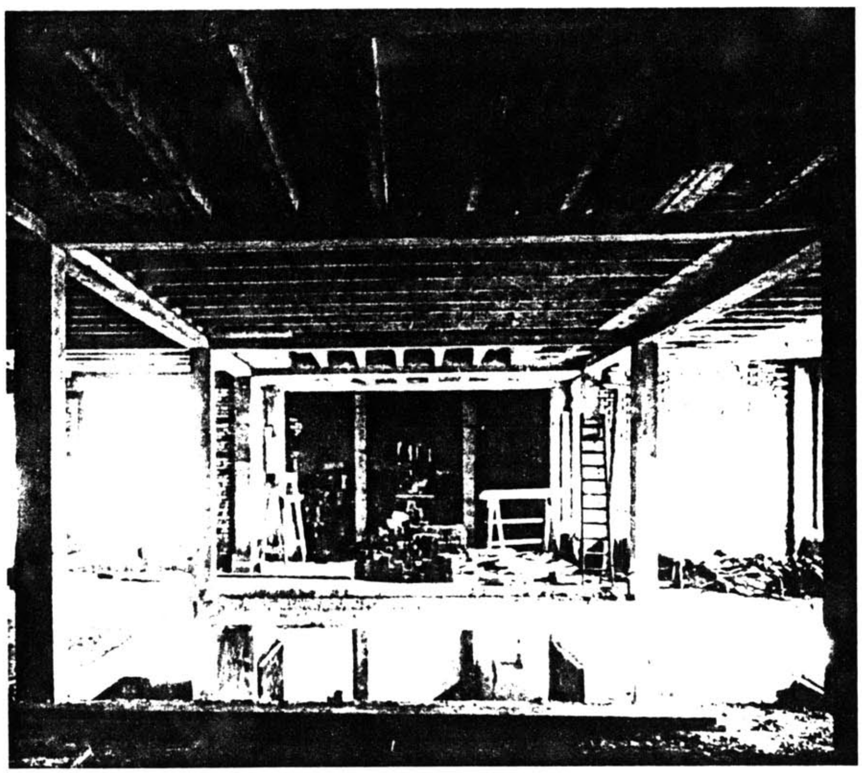


Fig.53. Le Corbusier
Villa Schwob: view of the structural skeleton, 1916
Source: Roberto Gargiani, Perret e Le Corbusier confronti, (Roma-Bari: Laterza, 1990), p.74.

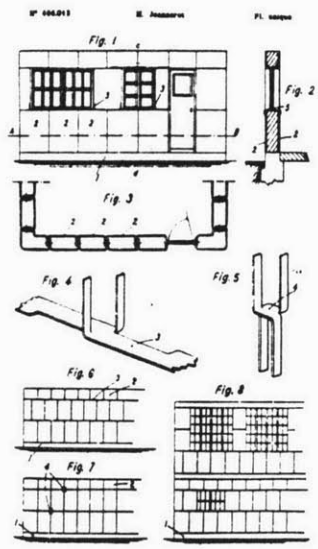
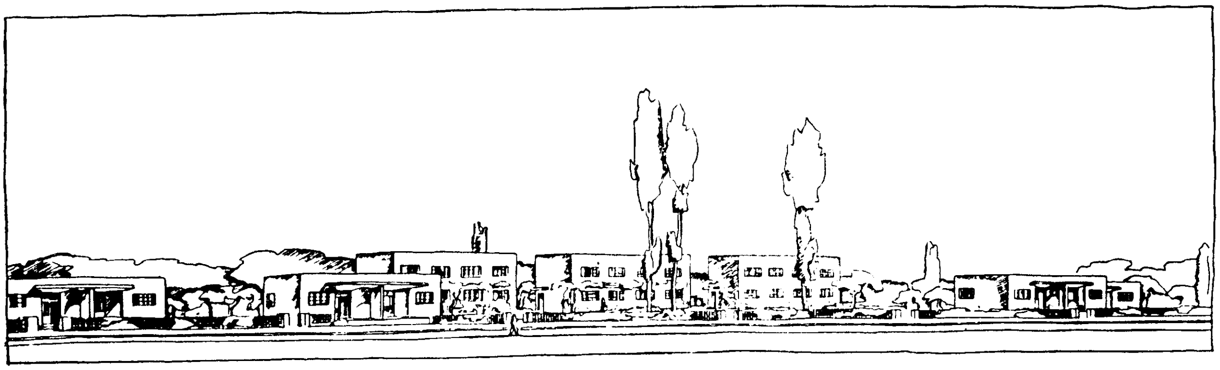


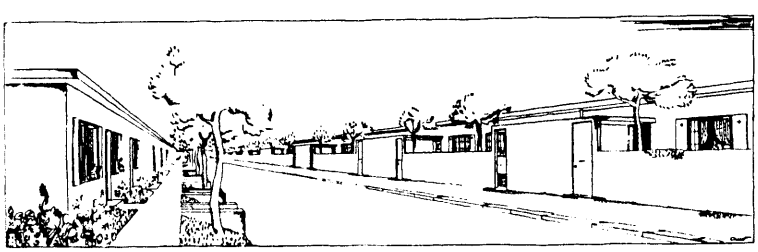
Fig.54. Le Corbusier
Patent: "Procédé de construction de murs par coffrage": diagrams, 1919
Source: INPI, Paris, in <u>Rassegna</u> no. 46 (1991), p.72.



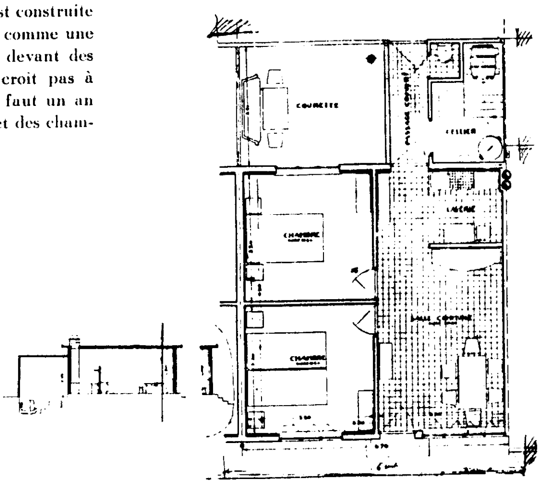
Maisons de gros béton (Troyes)

TROYES 1919 — Maisons de gros béton. Le terrain était formé de bancs de gravier. Une carrière est installée à même le terrain; le gravier est coulé avec de la chaux dans un banchage de 40 centimètres d'épaisseur; les planchers en ciment armé. Une esthétique spéciale naît directement du procédé. La bonne économie d'un chantier moderne exige l'emploi exclusif de la droite, la droite est la grande acquisition de l'architecture moderne, et c'est un bienfait. Il faut nettoyer de nos esprits les araignées romantiques.

Maisons en béton liquide. Elles sont coulées par le haut comme on remplirait une bouteille avec du ciment liquide. La maison est construite en trois jours. Elle sort du coffrage comme une pièce de fonte. Mais on se révolte devant des procédés si « désinvoltes »; on ne croit pas à une maison faite en trois jours; il faut un an et des toits pointus et des lucarnes et des chambres mansardées!



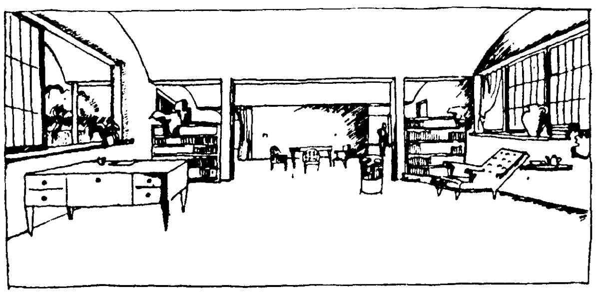
Maisons en béton liquide



Plan et coupe

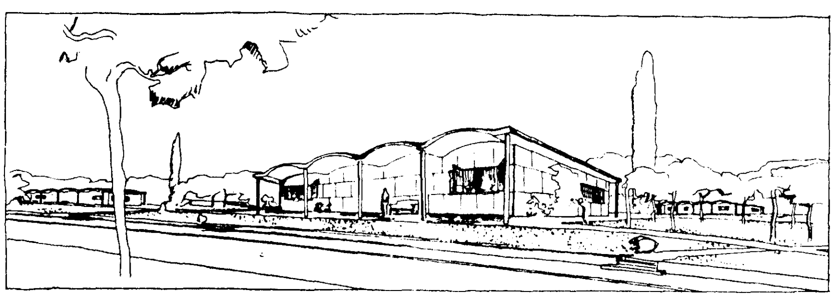
Fig.55. Le Corbusier
Project for the Maison de gros béton and Maison en béton liquide: perspectives, plan, and section, 1919
Source: Le Corbusier and Pierre Jeanneret, Oeuvre Complète de 1910-1929, p.29

Maisons « Monol » (deux étages)

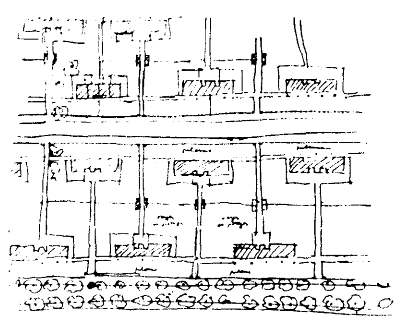


Intérieur d'une maison « Monol »

MAISON «MONOL» — Quand on parle de maisons en série, il faut parler de lotissement. L'unité des éléments constructifs est une garantie de beauté. La diversité nécessaire à un ensemble architectural est fournie par le lotissement qui conduit aux grandes ordonnances, aux véritables rythmes de l'architecture. Un village bien loti et construit en série donnerait une impression de calme, d'ordre, de propreté, imposerait fatalement la discipline aux habitants; l'Amérique nous montre l'exemple de la suppression des murs de clôture grâce à cet état d'esprit nouveau créé là-bas du respect de la propriété d'autrui; les banlieues en recevraient une impression d'espace, car le mur de clôture disparaissant, tout gagne en soleil et en clarté.



Maisons « Monol » (un étage)



Lotissement

Fig.56. Le Corbusier
Project for the Maison monol: exterior perspectives, interior perspective and site plan, 1920
Source: Le Corbusier and Pierre Jeanneret, Oeuvre Complète de 1910-1929, p.30.

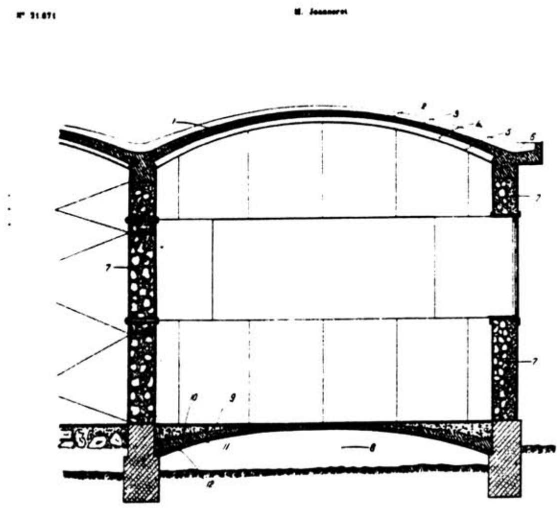


Fig.57. Le Corbusier
Patent "Procédé de construction de murs par coffrage": diagram for the roof and floor vaults for the Maison monol, 1919
Source: INPI, Paris, in Rassegna no. 46 (1991), p.72.

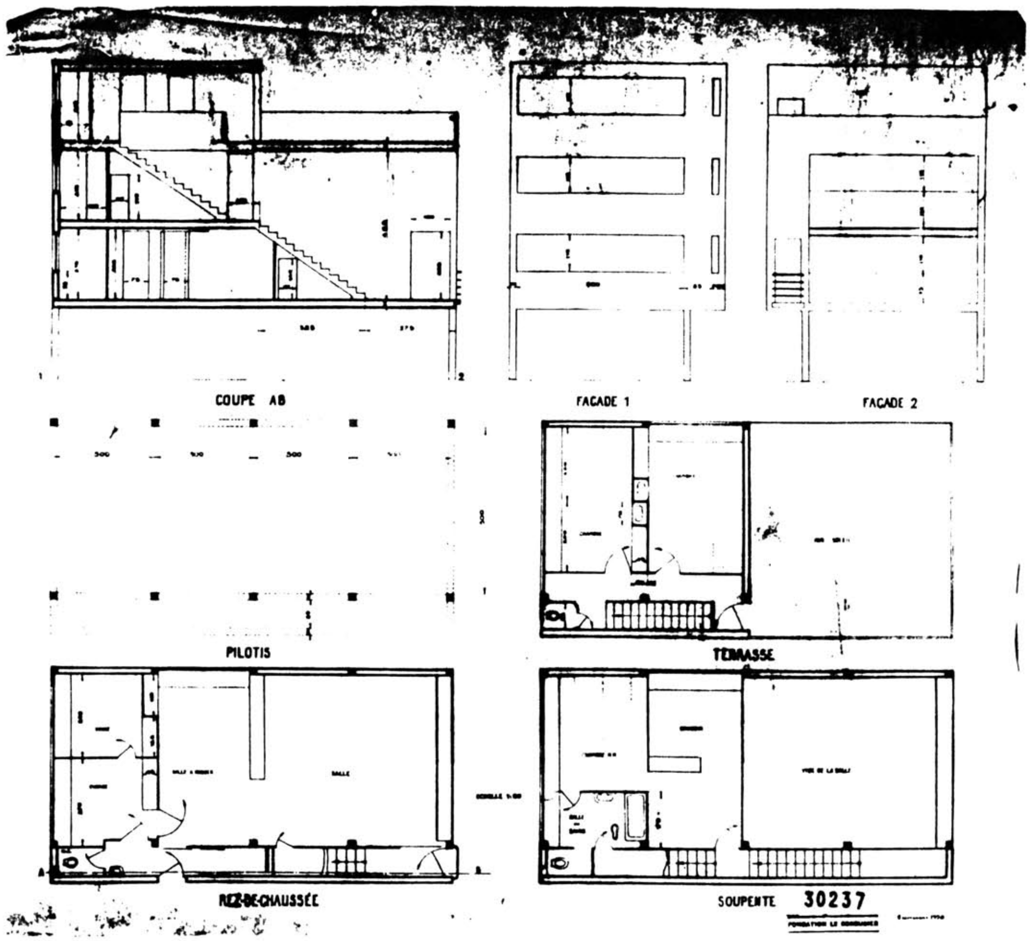


Fig.58. Le Corbusier
Project for the Maison Citrohan II: plans, section, and elevations, 1921
Source: <u>The Le Corbusier Archive</u>, vol.1, p.348

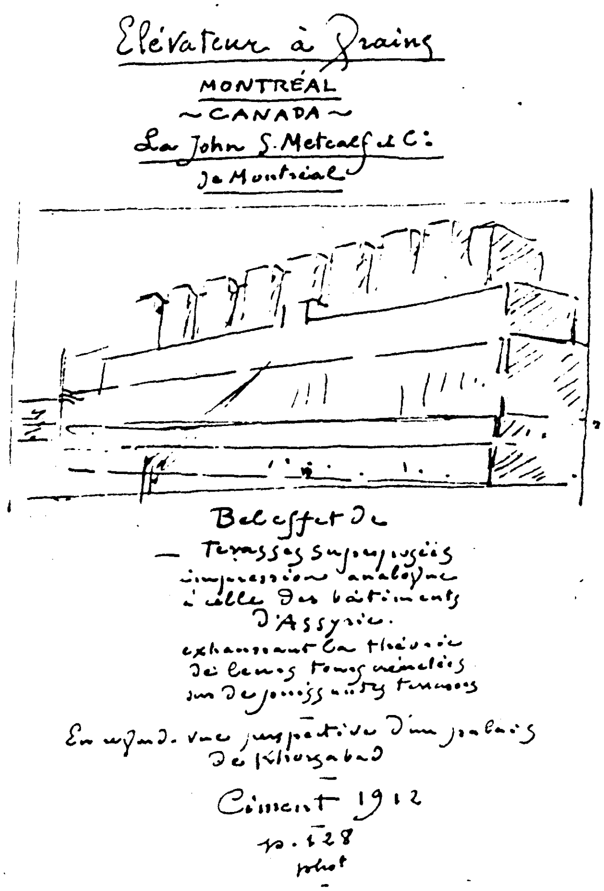


Fig.59. Charles Imbert
Sketch of grain elevators, 1924.
Source: Imbert, "L'Esthétique du béton armé," Manuscript, Fonds Perret, 535 AP 337.

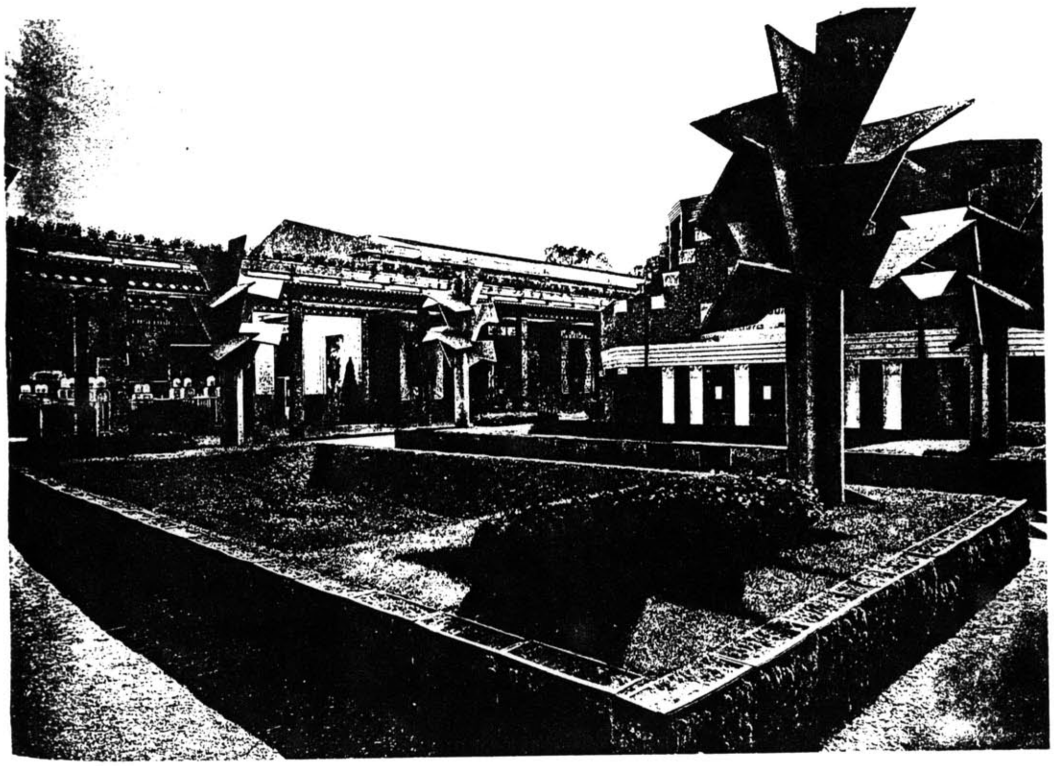


Fig.60. Jan and Joël Martel
Garden with concrete trees, 1925
Source: Dorothée Imbert, The Modernist Garden in France, (New Haven and London: Yale University Press, 1993), p.39.

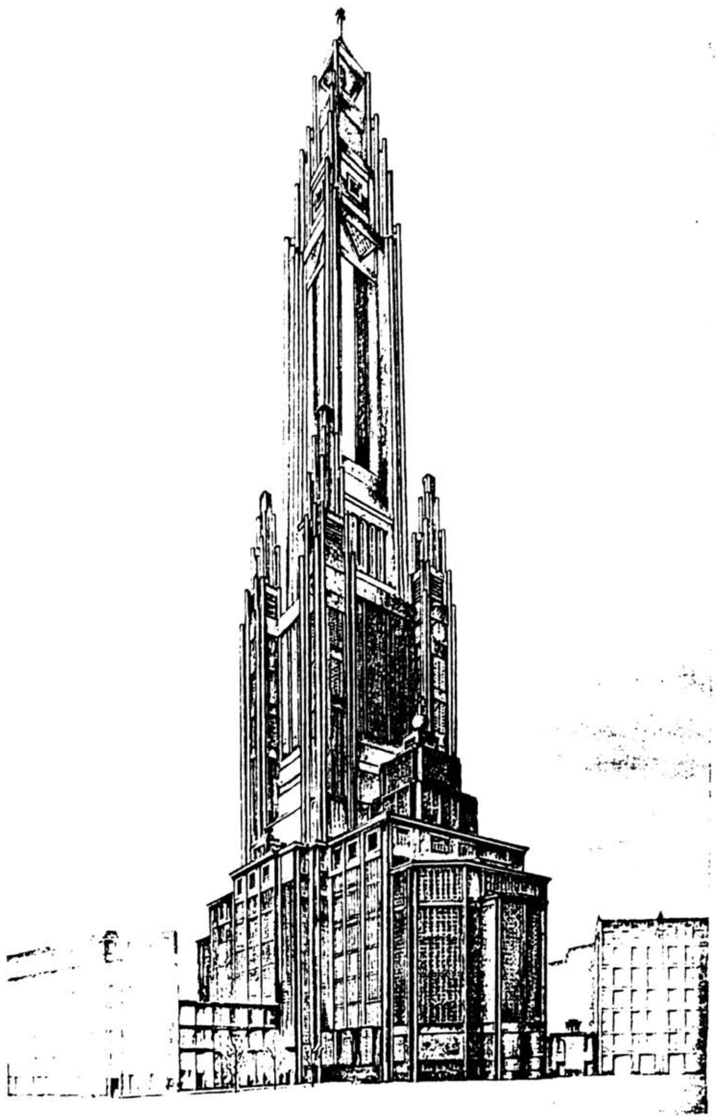


Fig.61. Auguste and Gustave Perret
Sainte-Jeanne-d'Arc: perspective, 1926
Source: Gargiani, August Perret. 1874-1954. Teoria e opere, p.138

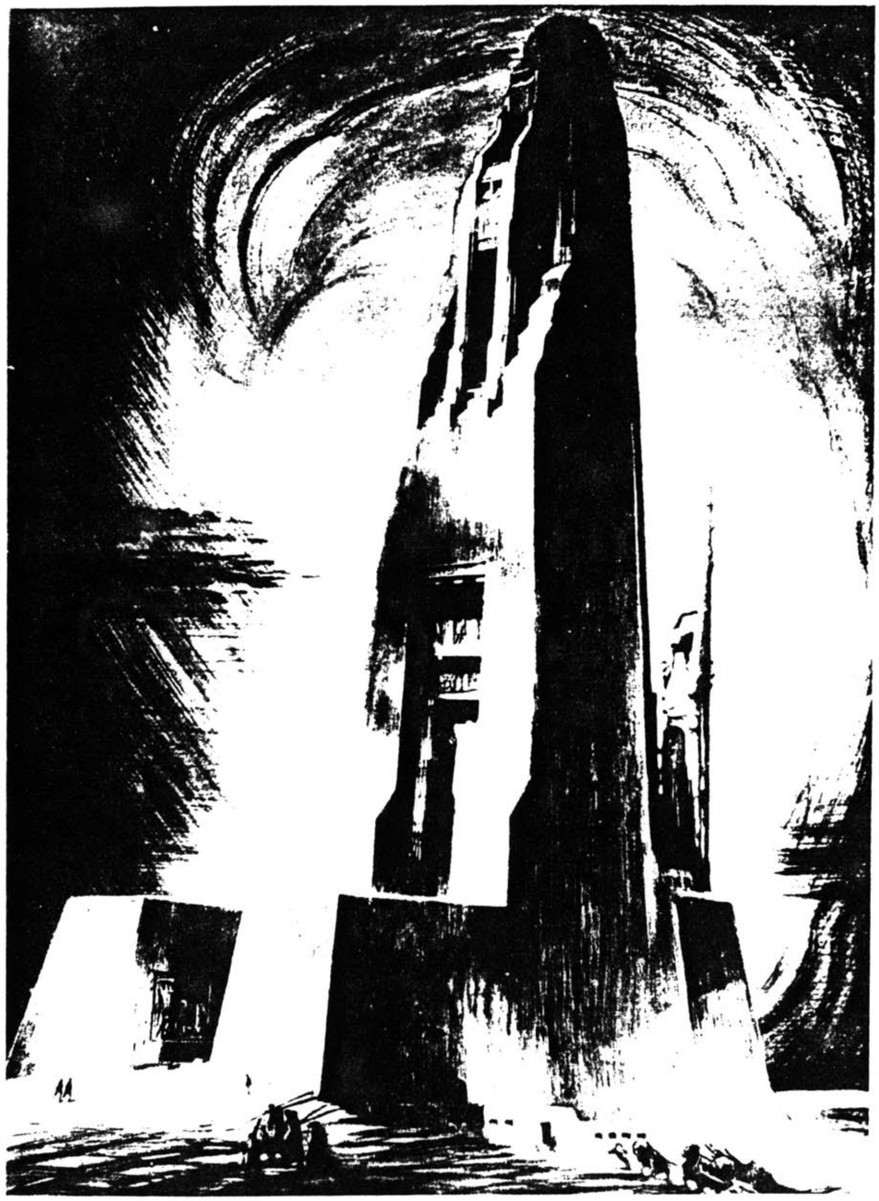


Fig.62. André Ventre
Monument for the Pointe de Grave: perspective, 1923
Source: L'Architecture Vivante vol.1 (Fall-Winter 1923), pl.14.

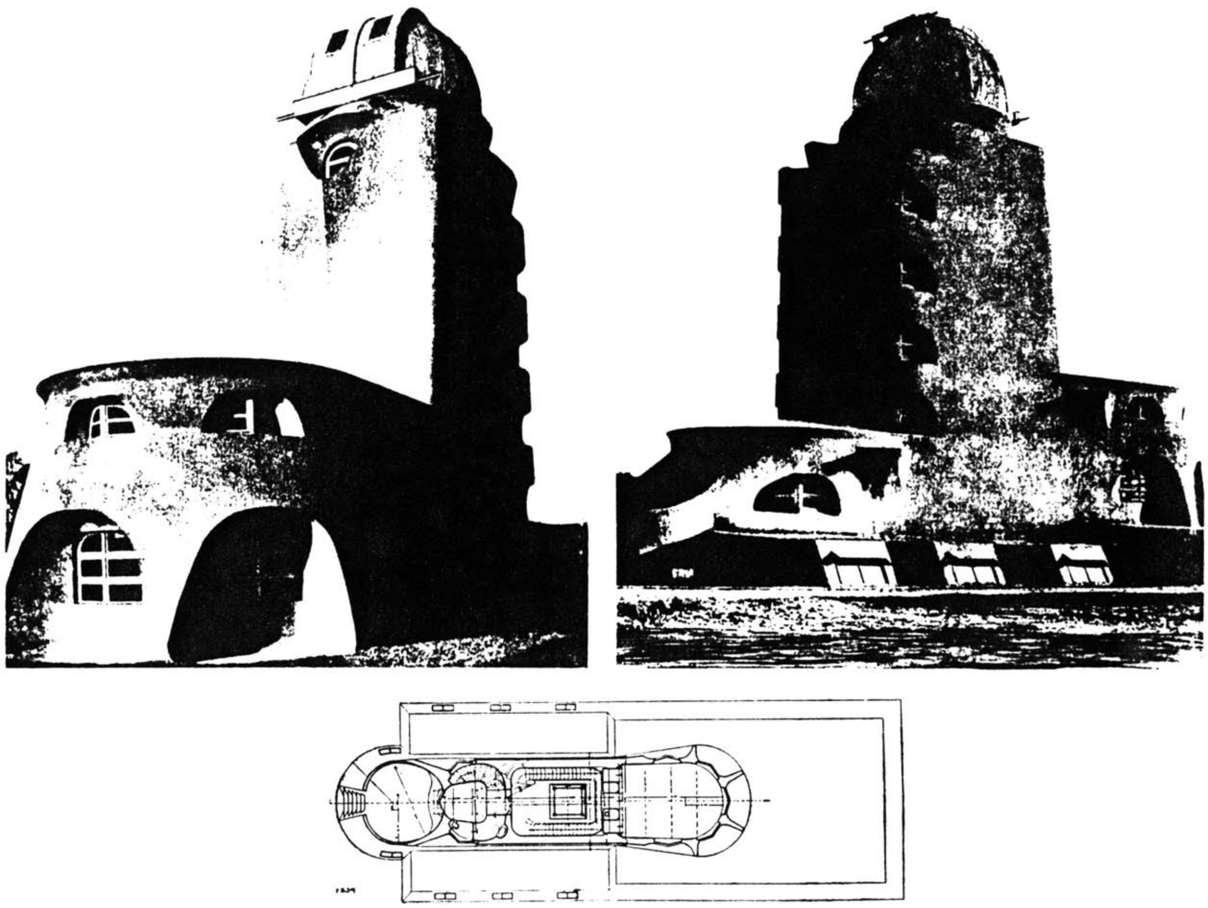


Fig.63. Erich Mendelsohn
Einstein tower: views and plan, 1923
Source: L'Architecture Vivante vol.3 (Spring-Summer 1925), pl.23.

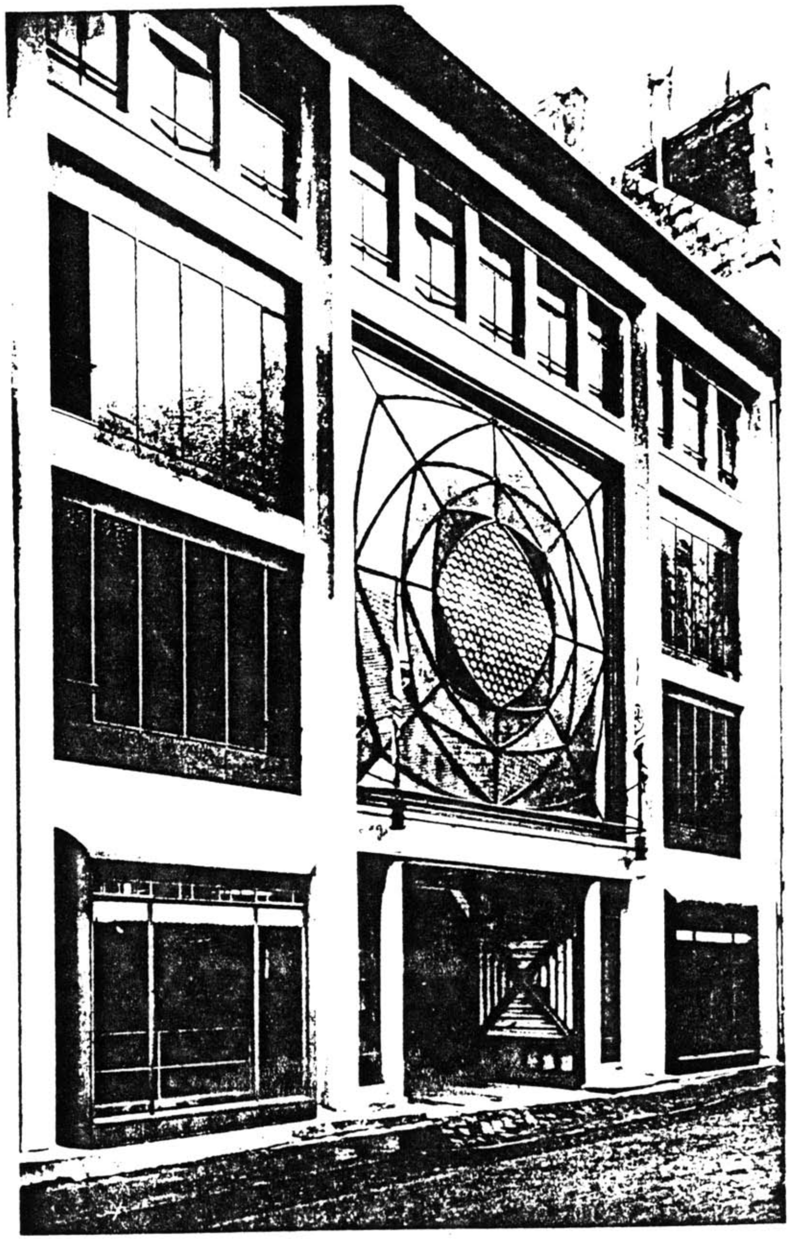


Fig.64. Auguste and Gustave Perret
Rue de Ponthieu garage: view of facade, 1907.
Source: Paul Jamot, A. G. Perret et l'architecture du béton armé, (Paris-Bruxelles: G. Vanoest, 1927), pl.IV.

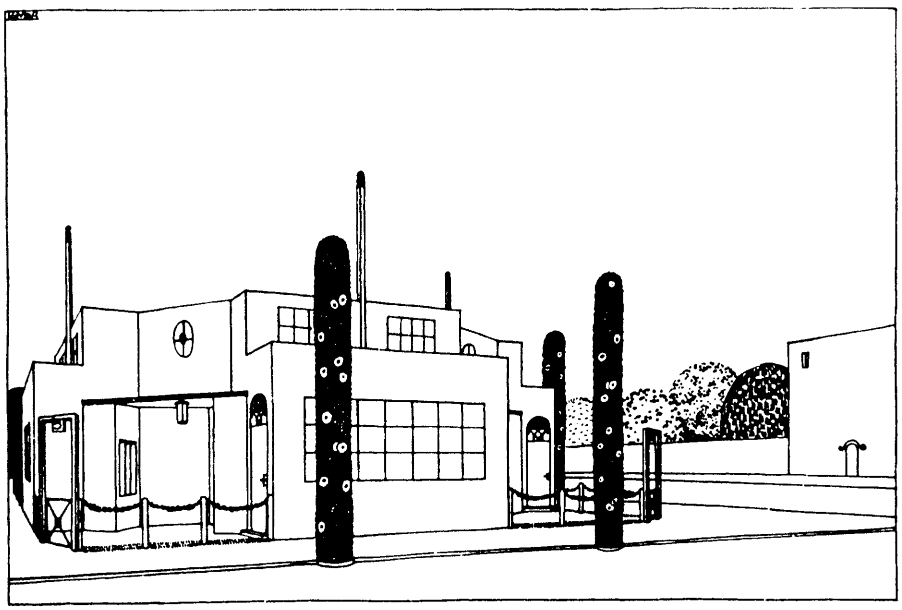


Fig.65. Robert Mallet-Stevens
Project for Maisons Ouvrieres: perspective, 1922
Source: Robert Mallet-Stevens, Une cité moderne, (Paris, Ch. Massin, 1922), pl.14.

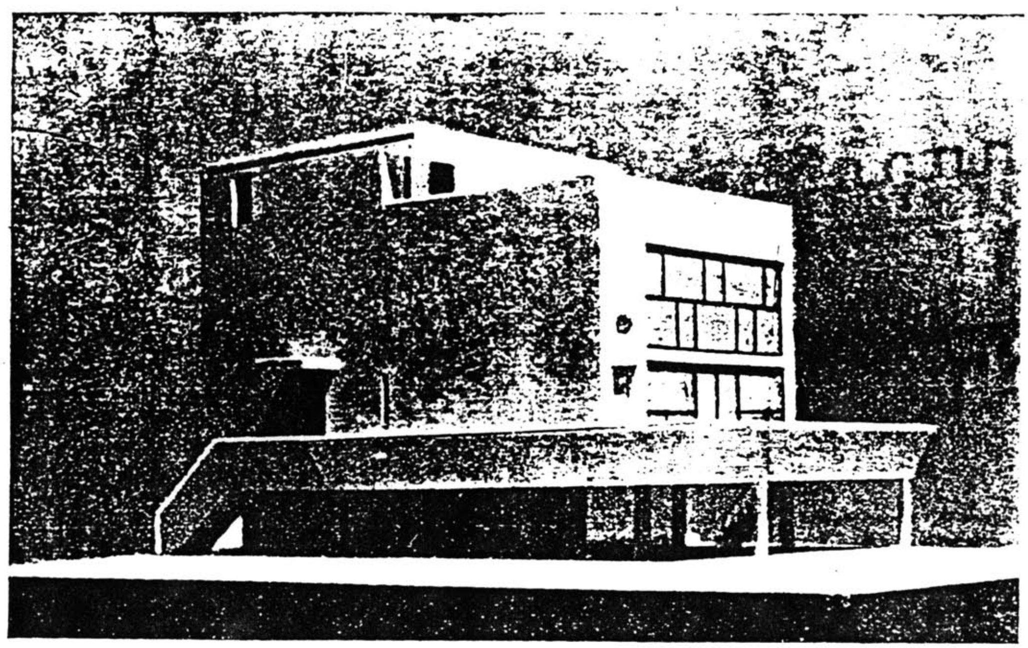
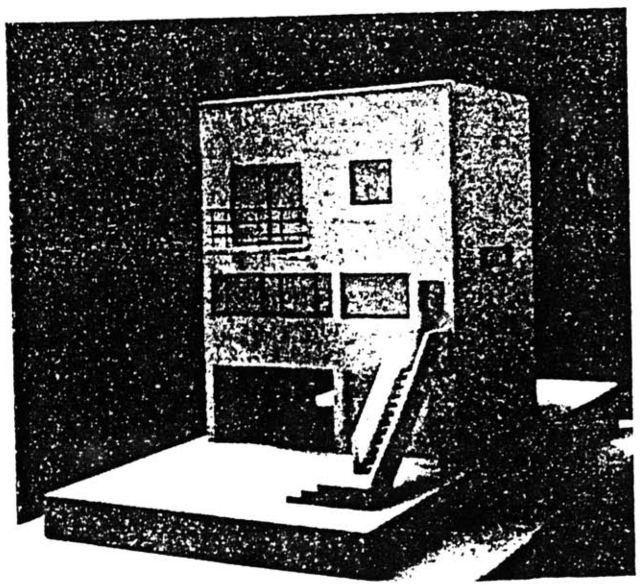


Fig.66. Le Corbusier
Maison Citrohan: model, 1921
Source: L'Amour d'Art vol.3, no.11 (November 1922), p.360.



LE CORBUSIER. — MAISON CONSTRUITE CONFORMÉMENT A LA LOI RIBOT.

Fig.67. Le Corbusier
Maison Ribot: model, 1923
Source: L'Architecture vol.34, no.23 (10 December 1923), p.373.

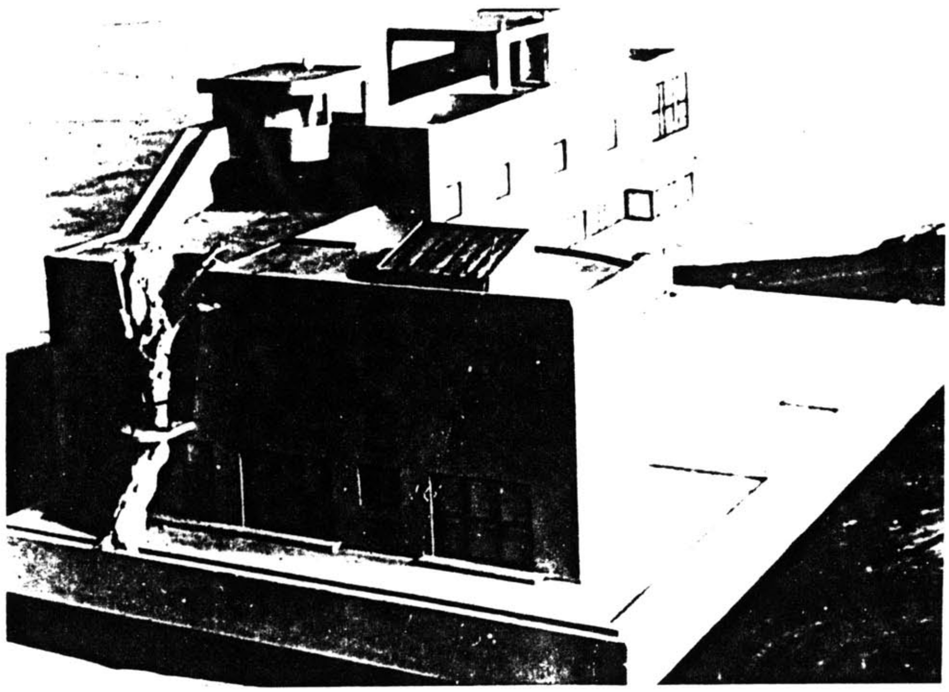


Fig.68. Le Corbusier
Villa La Roche-Jeanneret: model, 1923
Source: Yve-Alain Bois and Nancy Troy, eds., De Stijl et l'architecture de France, (Liège-Bruxelles: Pierre Mardaga, 1985), p.93.

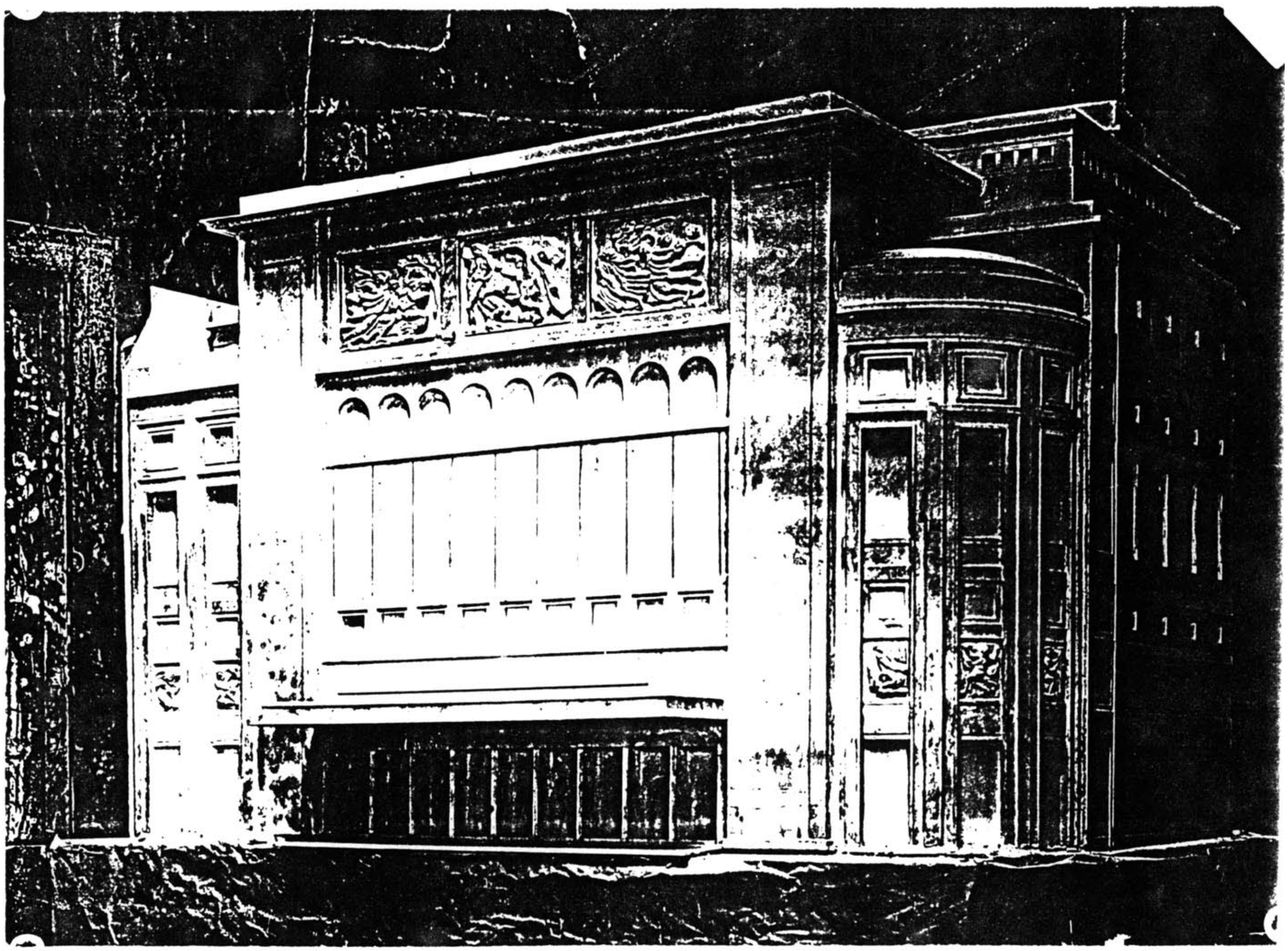


Fig.69. Auguste and Gustave Perret
Champs-Elysées Theater: view of plaster model by Spoerrer, 1911
Source: Fonds Perret

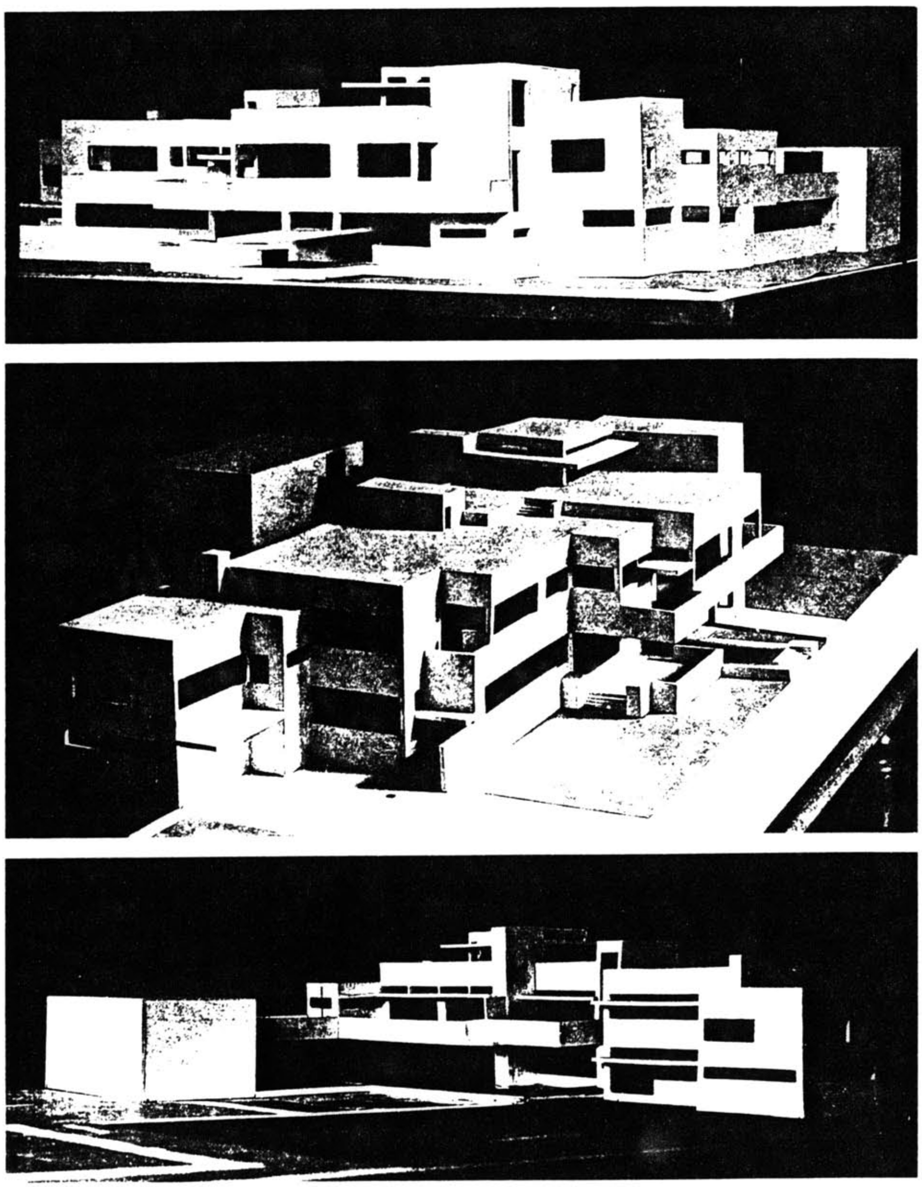


Fig.70. Theo van Doesburg and Cornelis van Eesteren
Project for the Hôtel Particulier: views of model, 1923.
Source: L'Architecture Vivante vol.3 (Spring-Summer 1925), pl.7.

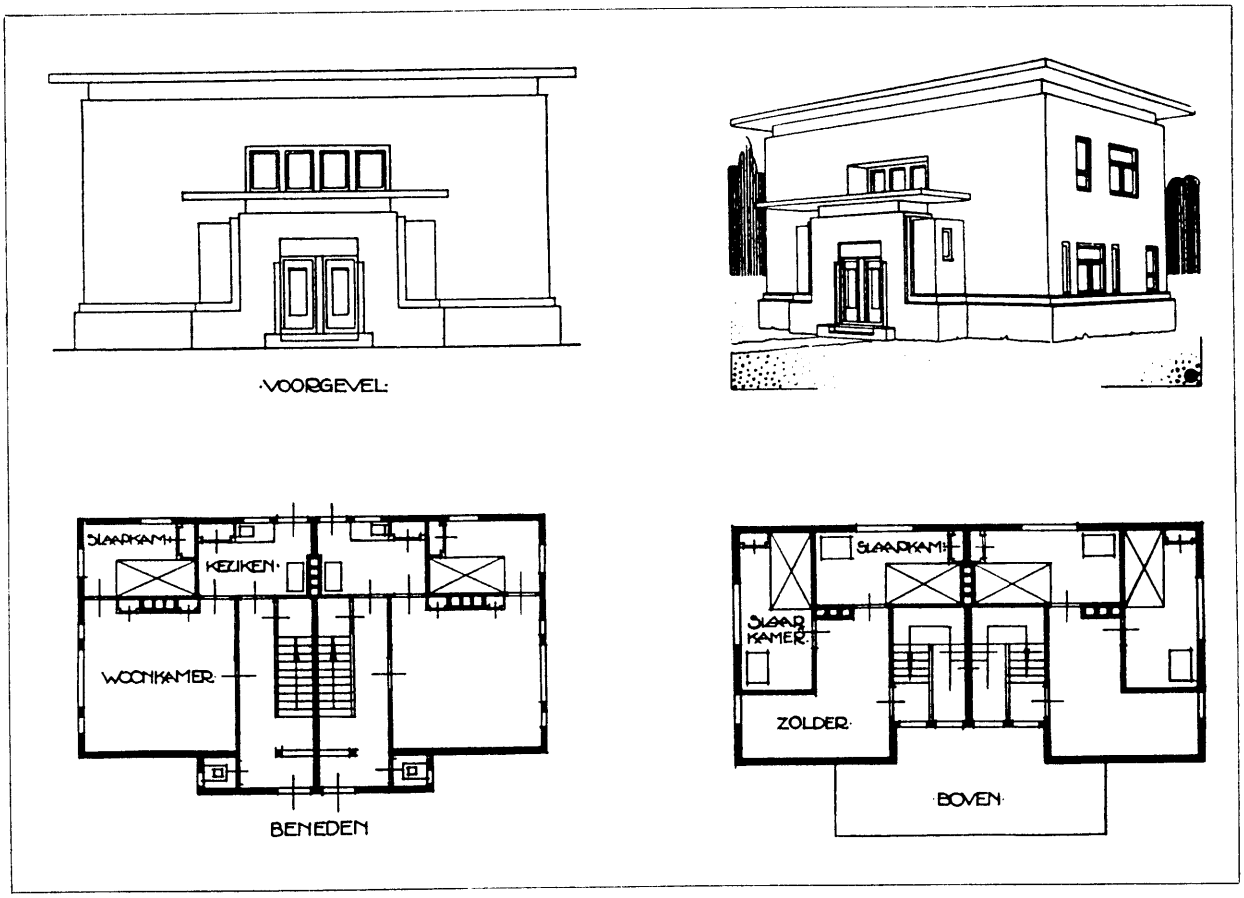


Fig.71. J.J.P. Oud
Maisons Ouvrières Jumelées en béton armé: elevation, perspective, and plans, 1917
Source: L'Architecture Vivante vol.2 (Spring-Summer 1924), pl.45.

Fig.72. Auguste and Gustave Perret
Maison Gaut:, 1923
Source: L'Architecture Vivante vol.2 (Spring-Summer 1924), pl.2.

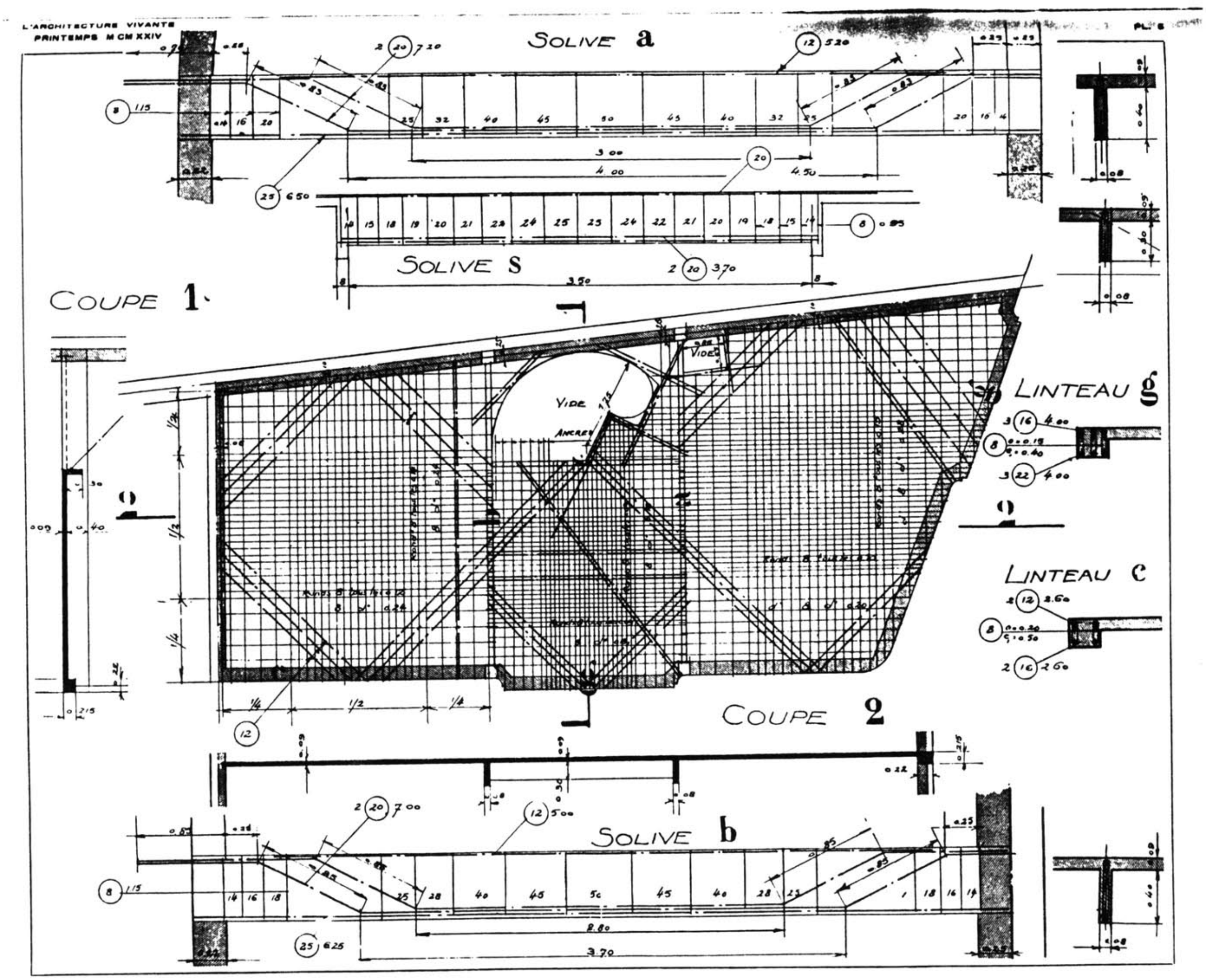


Fig.73. Auguste and Gustave Perret
Maison Gaut: working drawing for reinforced concrete floor, 1922
Source: L'Architecture Vivante vol.2 (Spring-Summer 1924), pl.5.

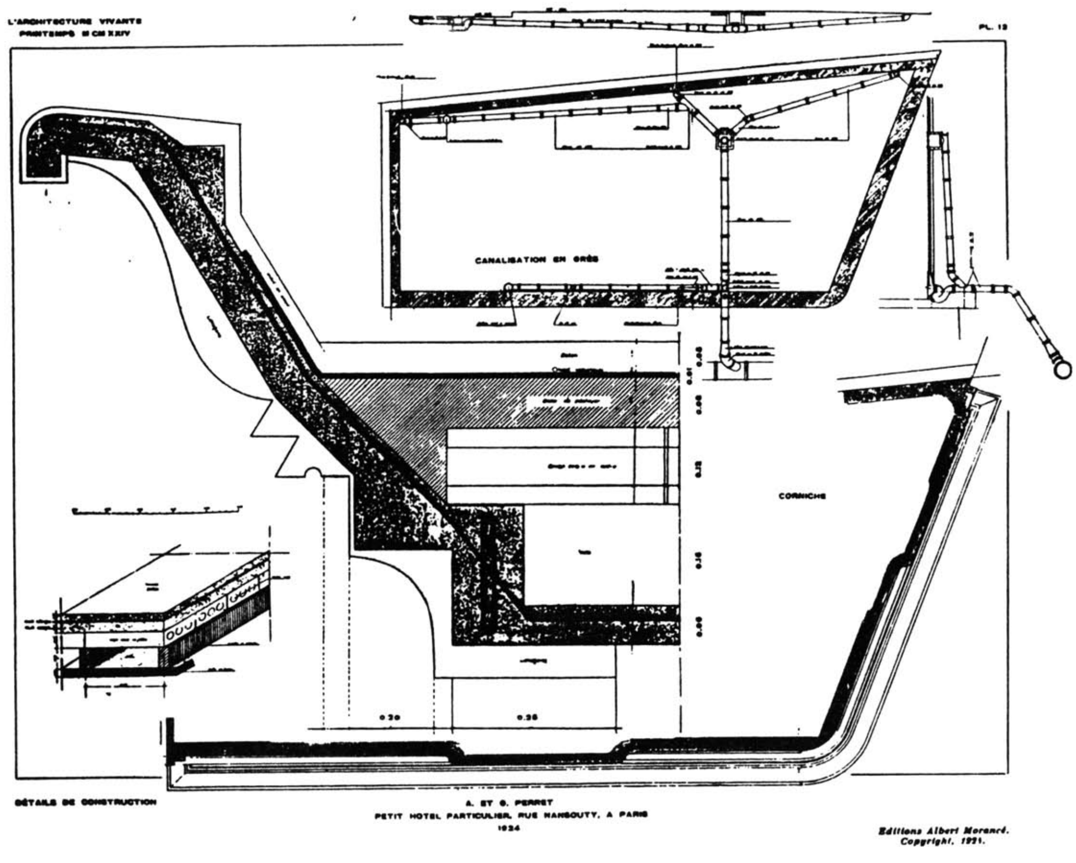


Fig.74. Auguste and Gustave Perret
Maison Gaut: working drawing for the cornice, 1922
Source: L'Architecture Vivante vol.2 (Spring-Summer 1924), pl.12.

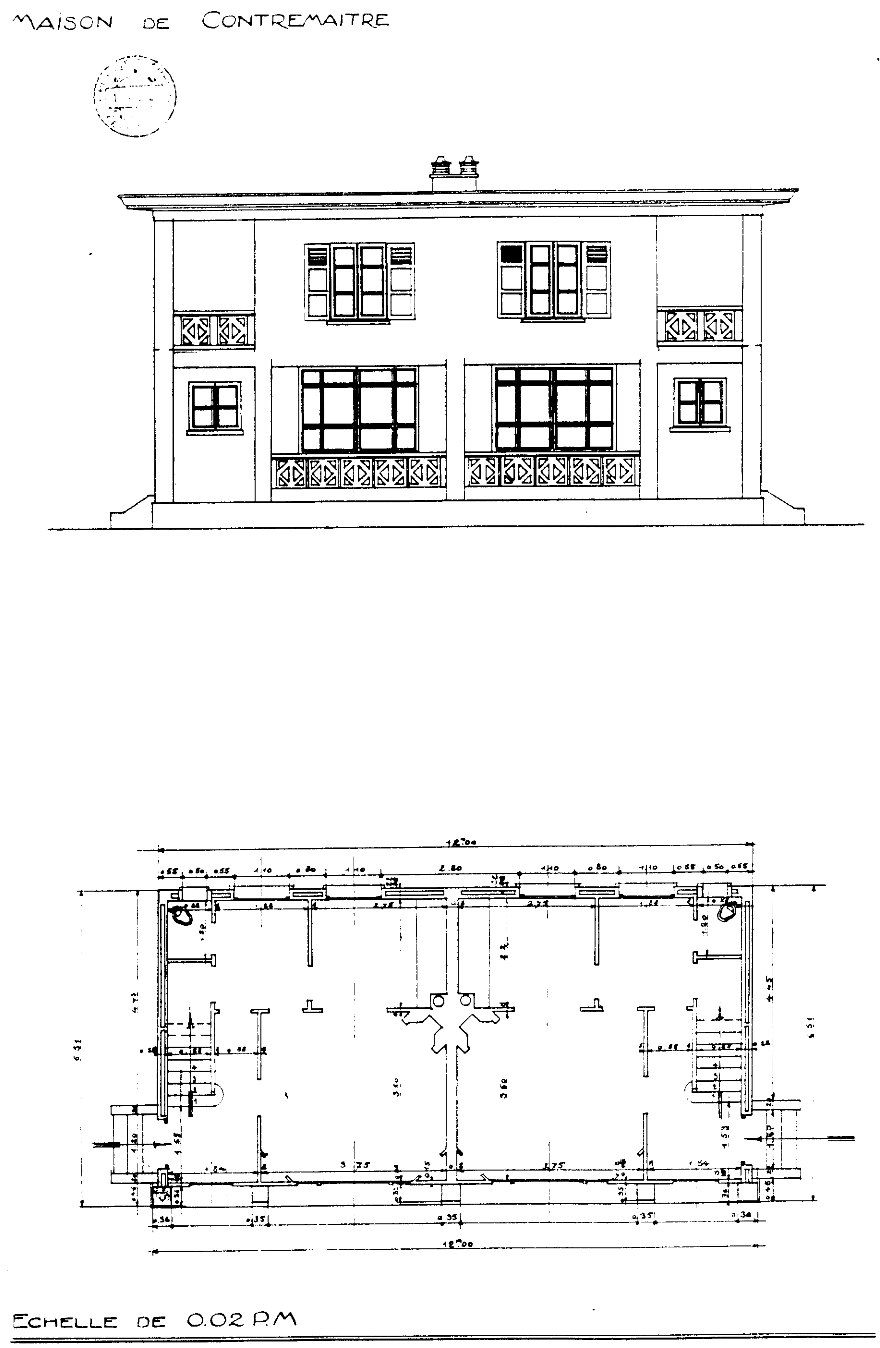


Fig.75. Gustave Perret
Maison de Contremaitre, Grand Quévilly: plan and elevation, 1922
Source: Fonds Perret

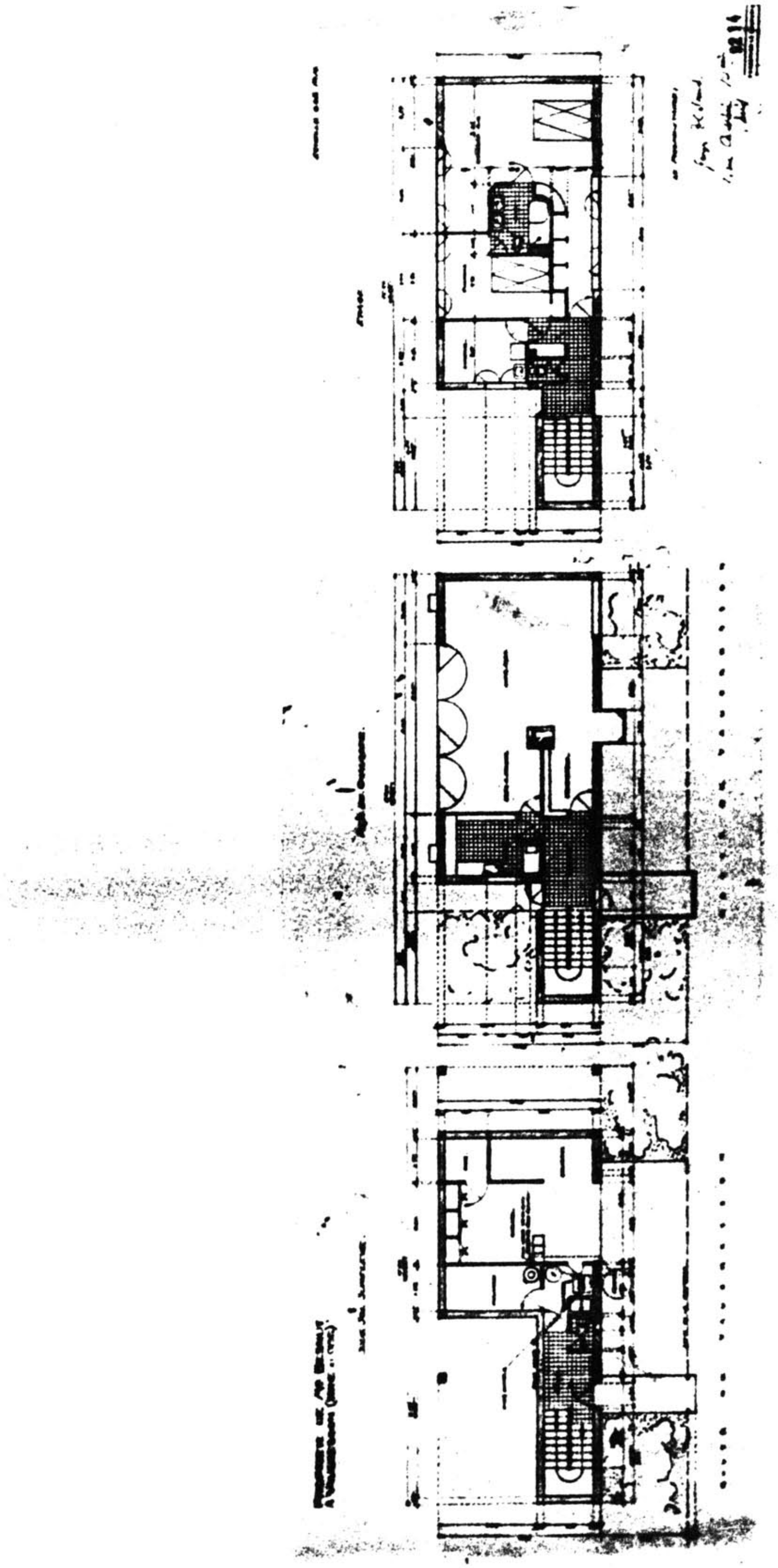


Fig.76. Le Corbusier
Maison Besnus , Vaucresson: working drawing for plan,
1922
Source: The Le Corbusier Archive, vol.1, p.408.

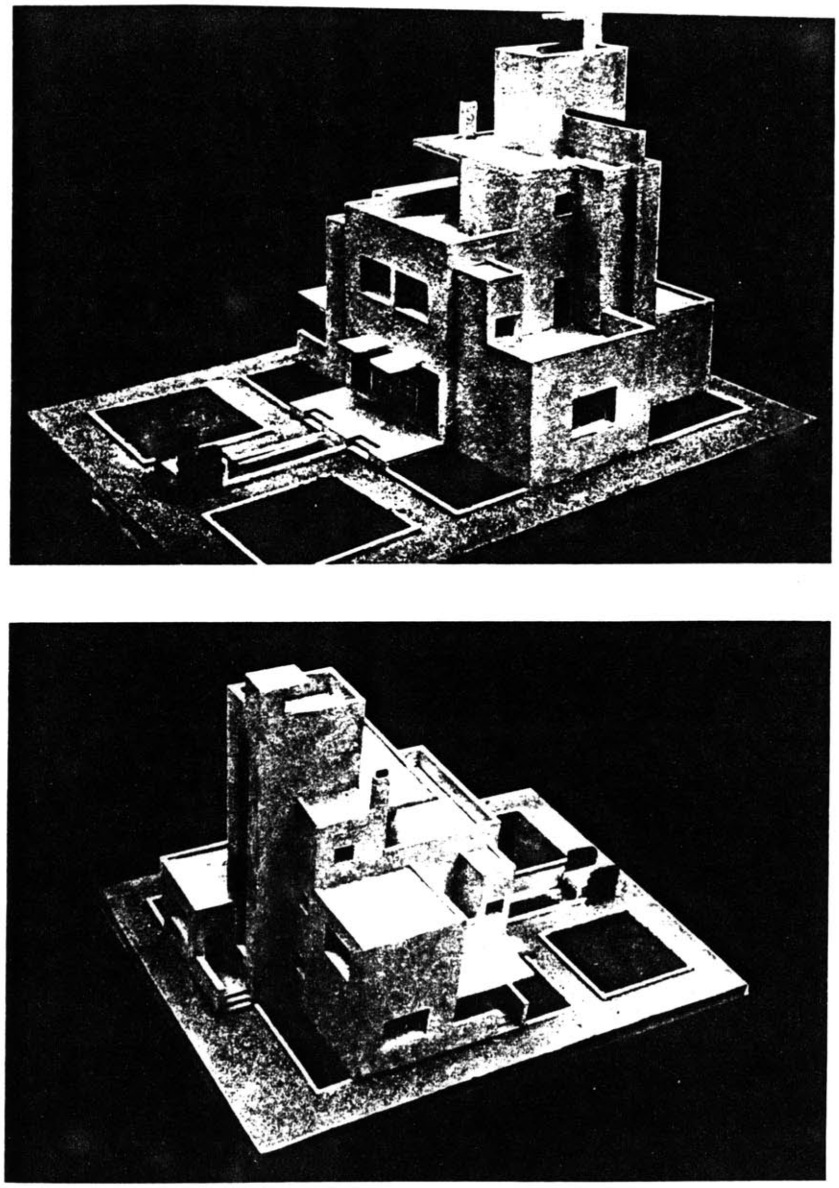


Fig.77. Robert Mallet-Stevens
Villa 1924: views of model, 1924
Source: L'Architecture Vivante vol.2 (Spring-Summer 1924), pl.46.

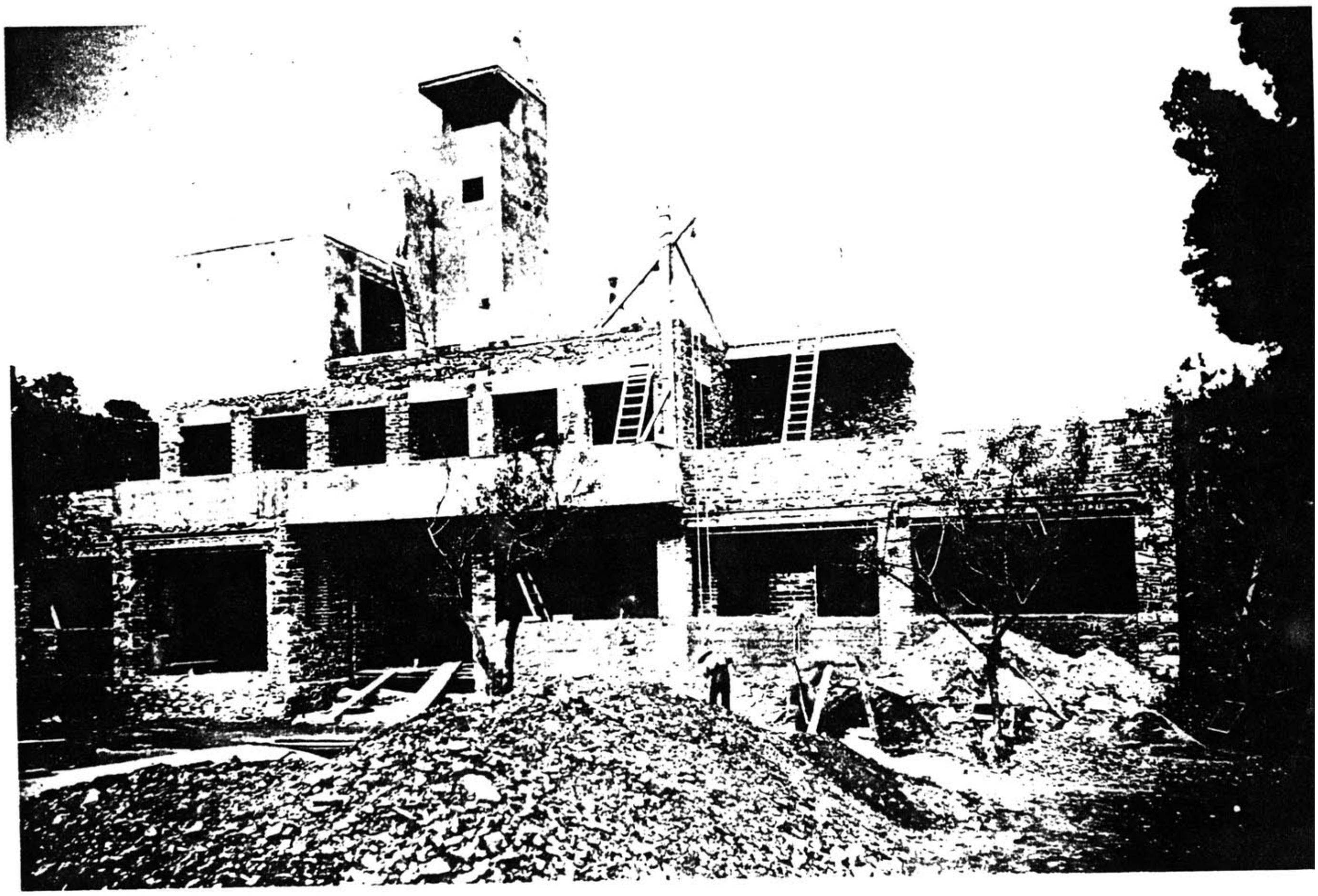
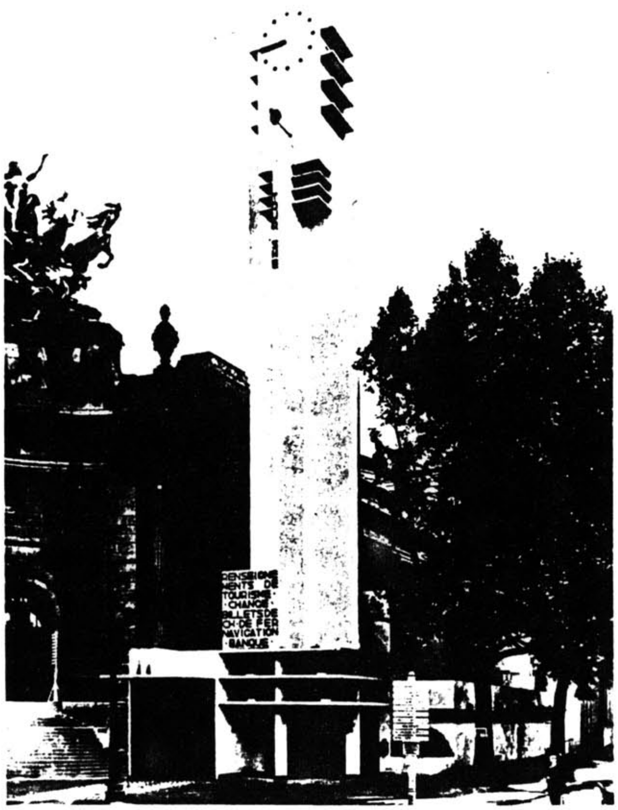


Fig.78. Robert Mallet-Stevens
Villa at Noailles: view during construction, 1924
Source: Cécile Briolle, et al., Rob Mallet-Stevens La Villa Noailles, (Marseilles: Editions Parenthèses, 1990), p.38.



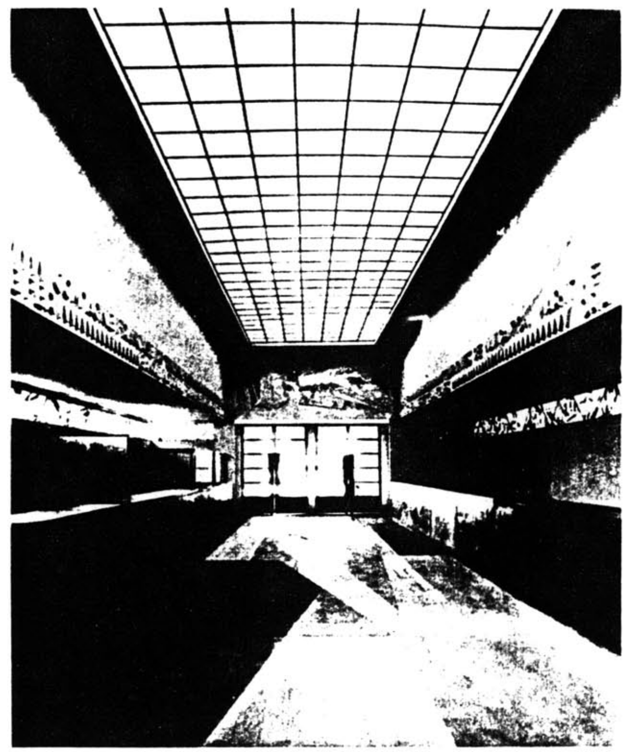
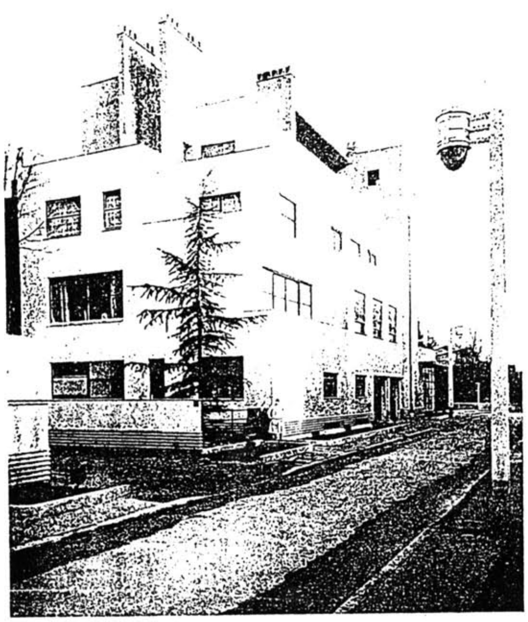


Fig.79. Robert Mallet-Stevens
Pavillon du Tourisme: view of tower and interior, 1925
Source: Jean-François Pinchon, ed., Rob. Mallet-Stevens: Architecture, Furniture, Interior Design, (Cambridge: The MIT Press, 1990), p.65.



Vue de l'hôtel Reifenberg publiée dans *Rob Mallet-Stevens architecte*, A.A.M. 1980, p.262.

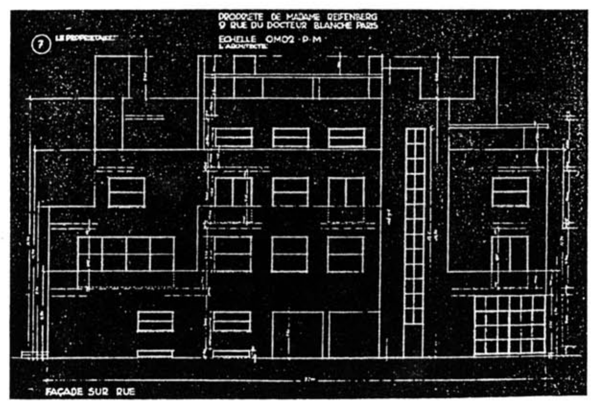
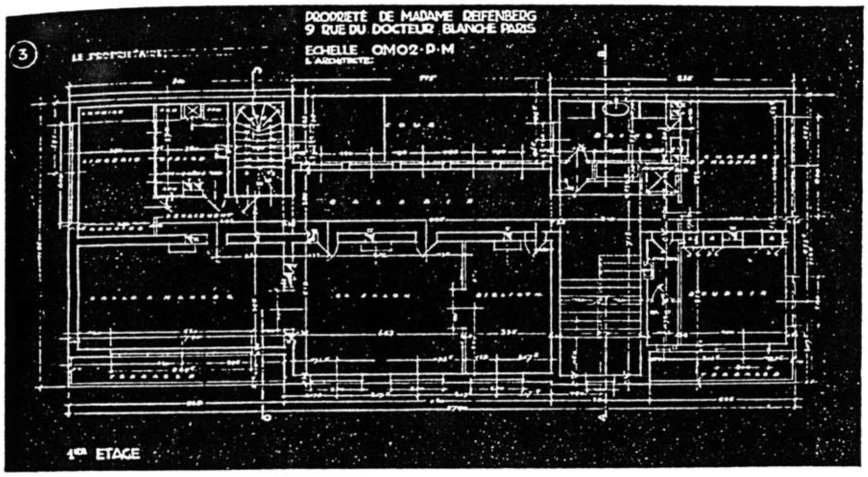


Fig.80. Robert Mallet-Stevens
Reifenberg house, 1925-1927
Source: Gilles Ragot, "Le Mouvement Moderne 1922-1933: Exigences et Compromis," vol.3 (Ph.D. diss., Paris IV, 1993), p.562.



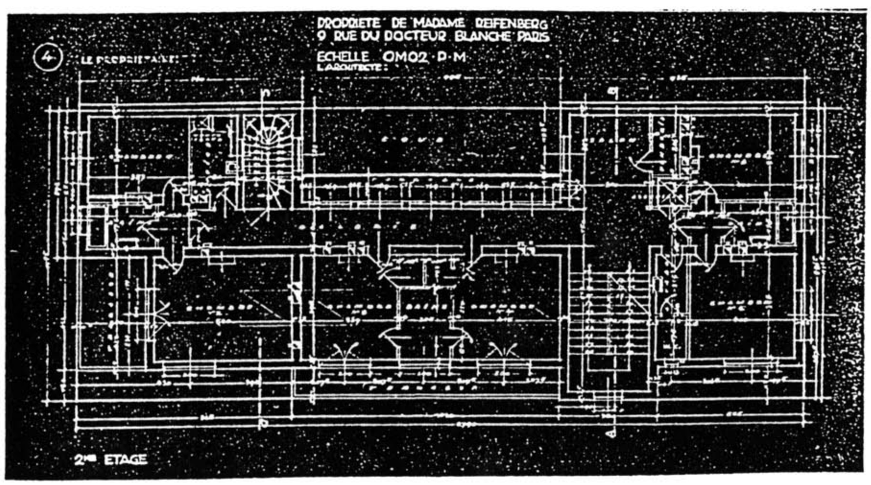


Fig.81. Robert Mallet-Stevens
Reifenberg house: floor plans, 1925-1927
Source: Ragot, "Le Mouvement Moderne 1922-1933: Exigences et Compromis," vol.3, p.565.

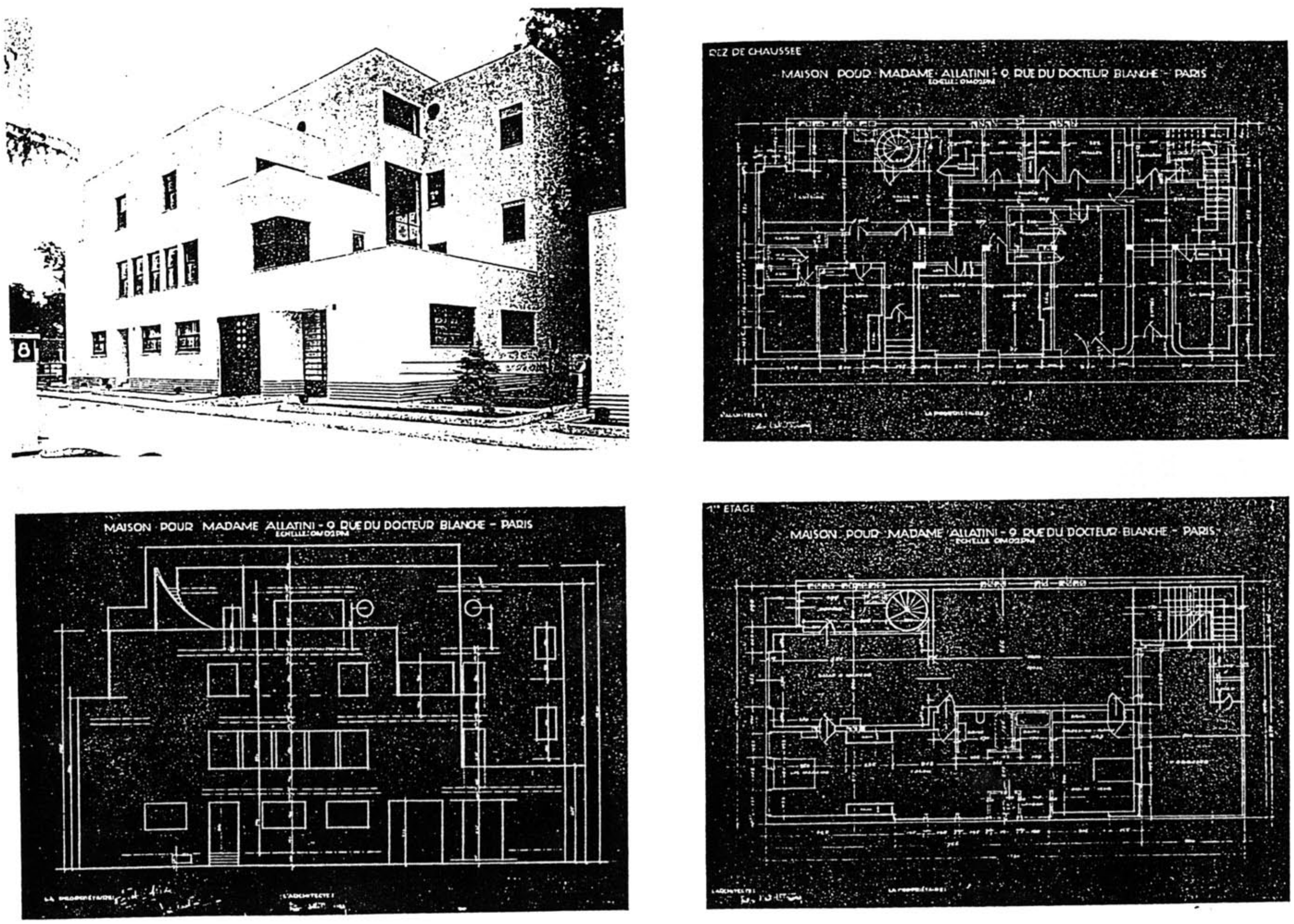
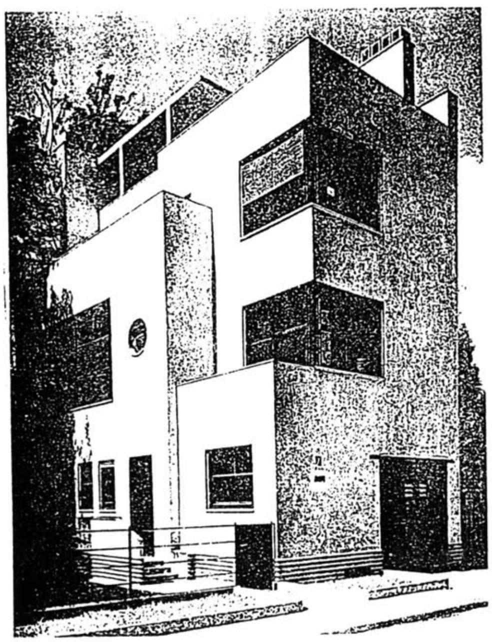
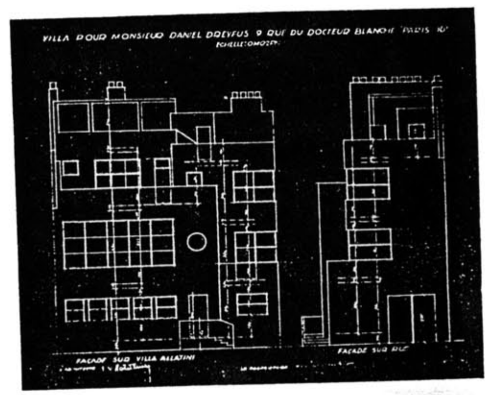


Fig.82. Robert Mallet-Stevens
Villa Allatini: view of completed structure, elevation, and plans, 1925-1928
Source: Ragot, "Le Mouvement Moderne 1922-1933: Exigences et Compromis," vol.3, pp.568-569.





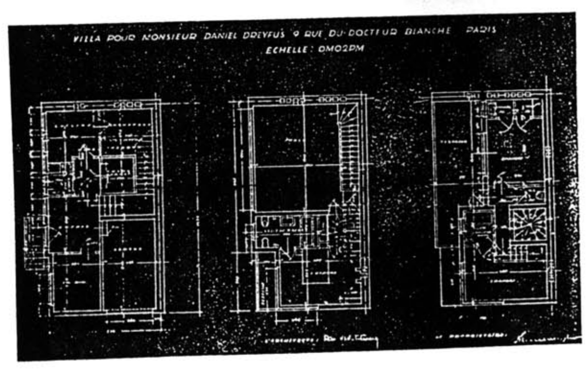


Fig.83. Robert Mallet-Stevens
Dreyfus house: view of completed structure, elevation, and plan, 1925-1928
Source: Ragot, "Le Mouvement Moderne 1922-1933: Exigences et Compromis," vol.3, pp.574, 576.

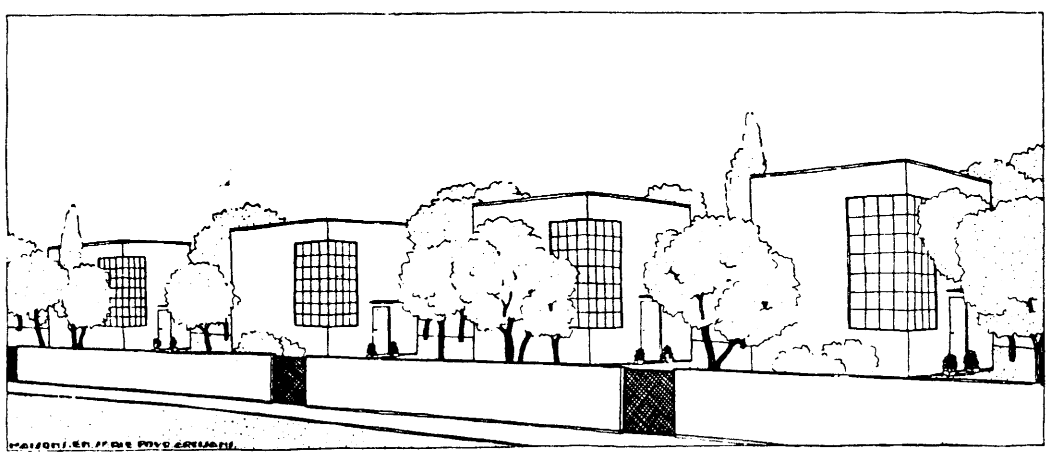


Fig.84. André Lurçat
Maisons en série pour artisans, 1924
Source: Jean-Louis Cohen, *André Lurçat 1894-1970: autocritique d'un moderne*, (Paris-Lièges: IFA-Mardaga, 1995), p.26.

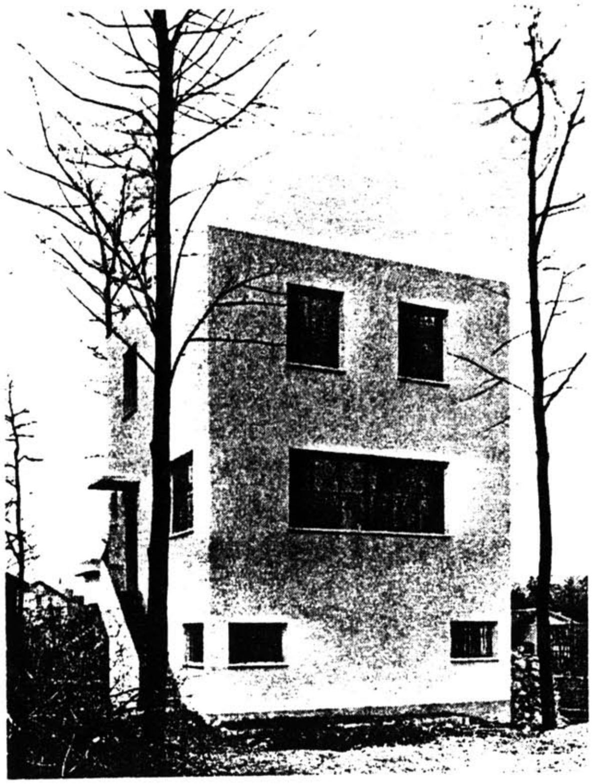


Fig.85. André Lurçat
Maison Rousset, Eaubonne, 1924
Source: Cohen, *André Lurçat 1894-1970: autocritique d'un moderne*, p.27.

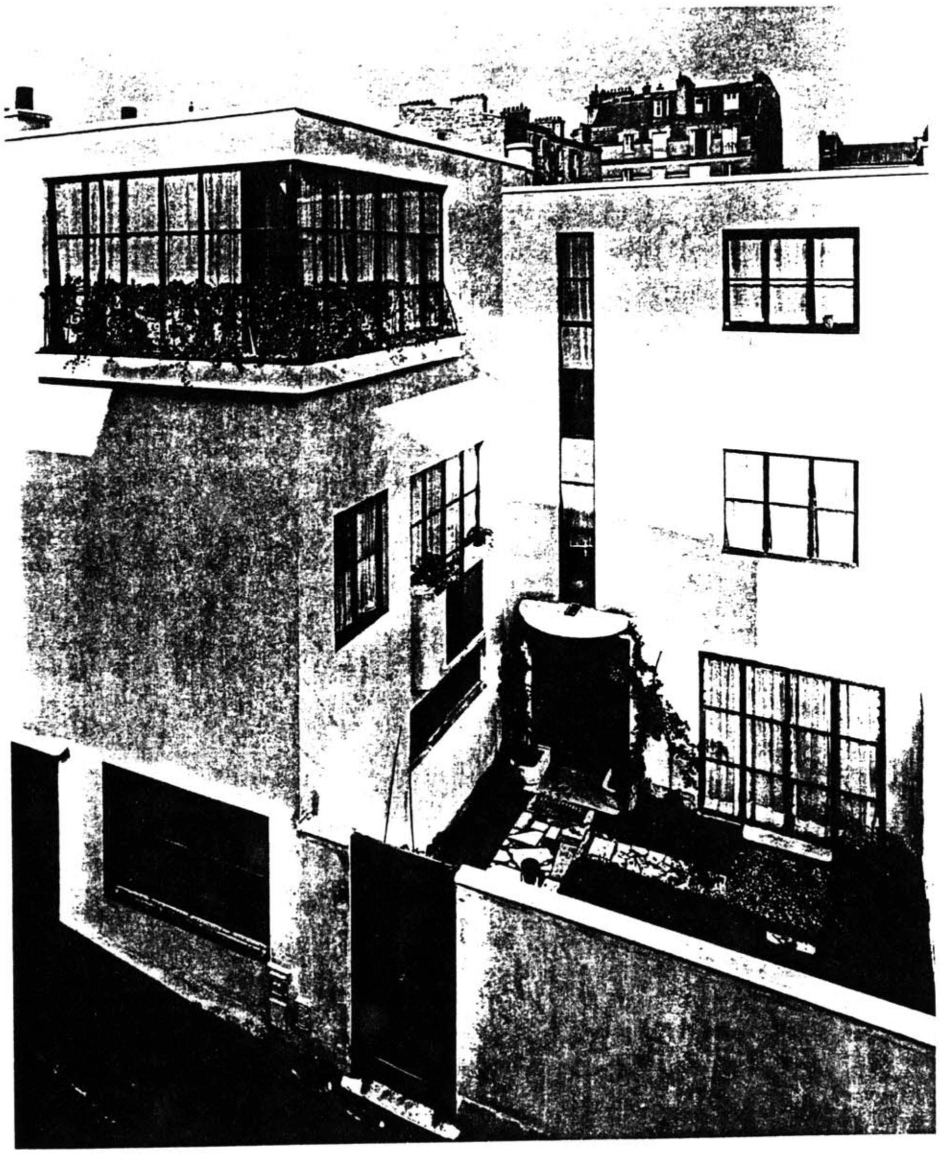


Fig.86. André Lurçat
Maison Jean Lurçat, 1924
Source: Cohen, *André Lurçat 1894-1970: autocritique d'un moderne*, p.33.

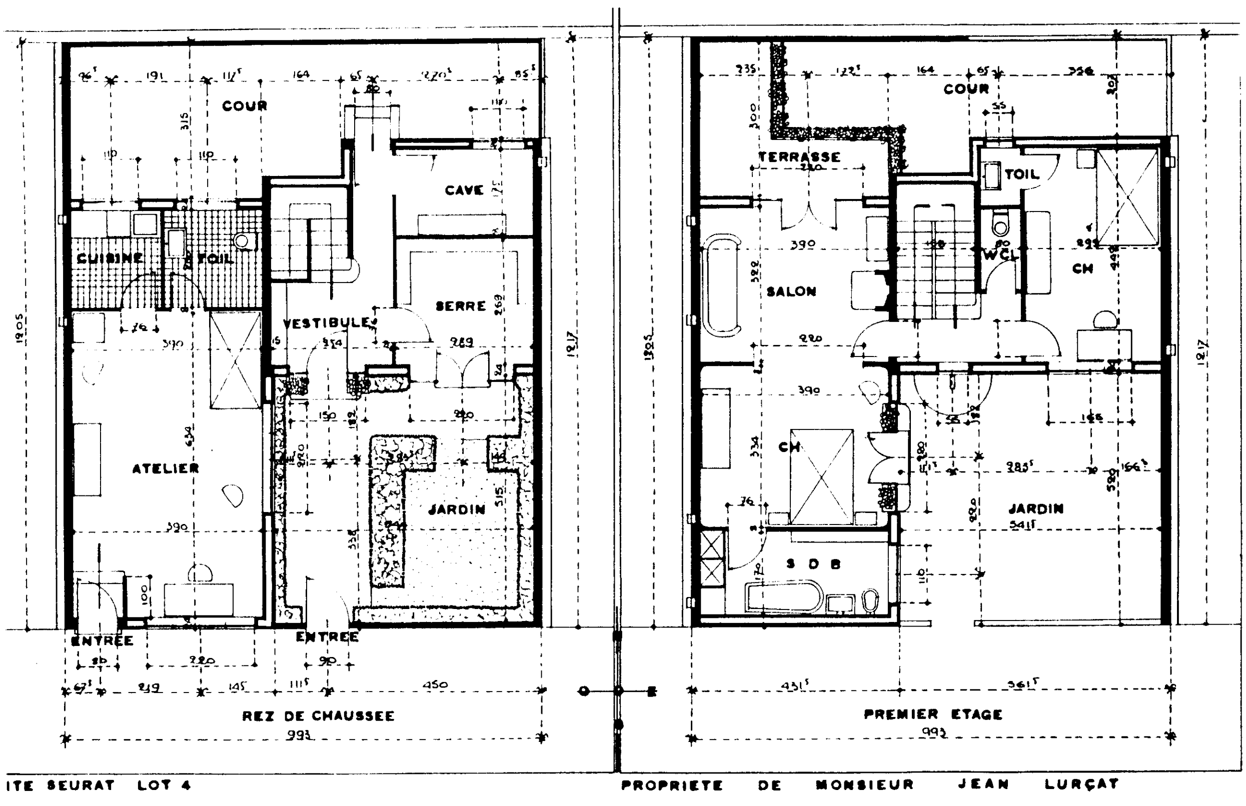


Fig.87. André Lurçat
Maison Jean Lurçat: working drawing for plans, 1924
Source: Fonds Lurçat

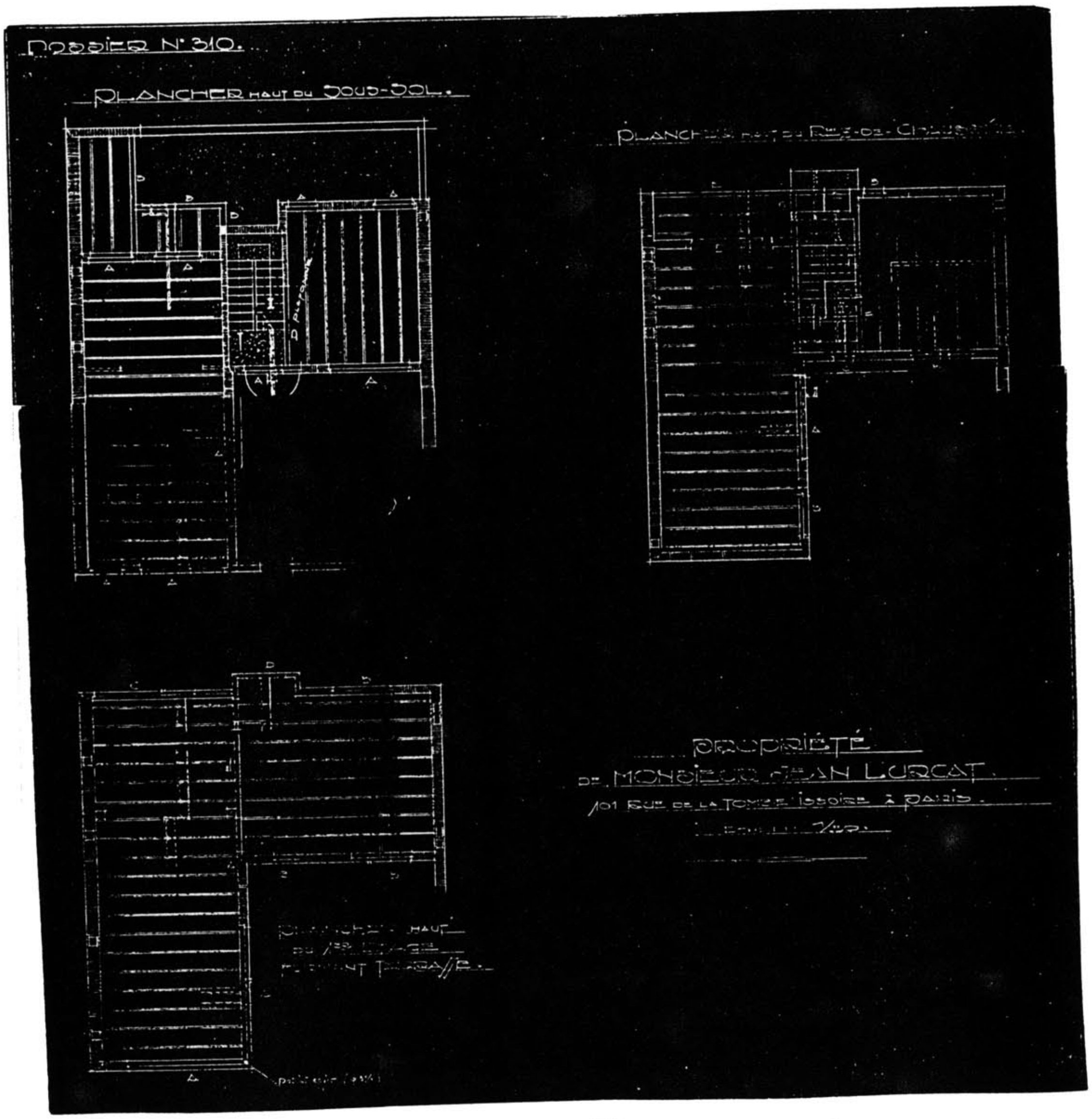


Fig.88. André Lurçat
Maison Jean Lurçat: working drawing for reinforced concrete floors 1924
Source: Fonds Lurçat

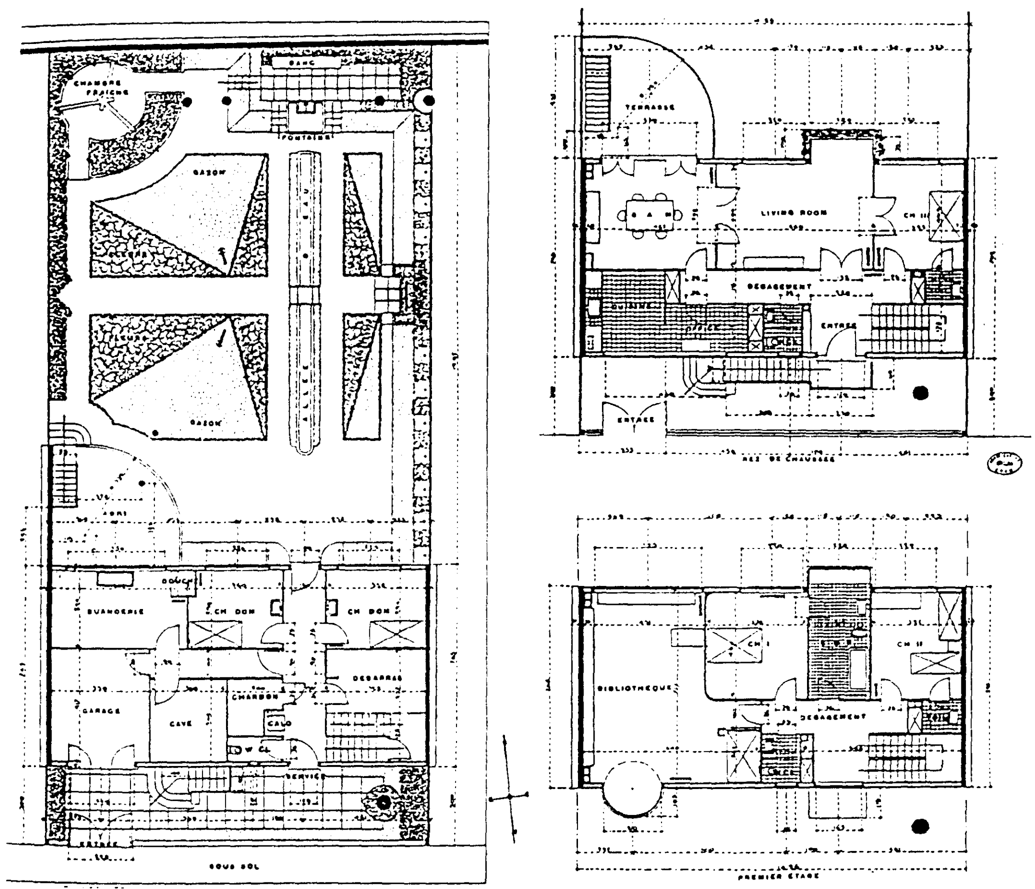


Fig.89. André Lurçat
Villa Bomsel: plans, 1924-1926
Source: Ragot, "Le Mouvement Moderne 1922-1933: Exigences et Compromis," vol.3, p.447.

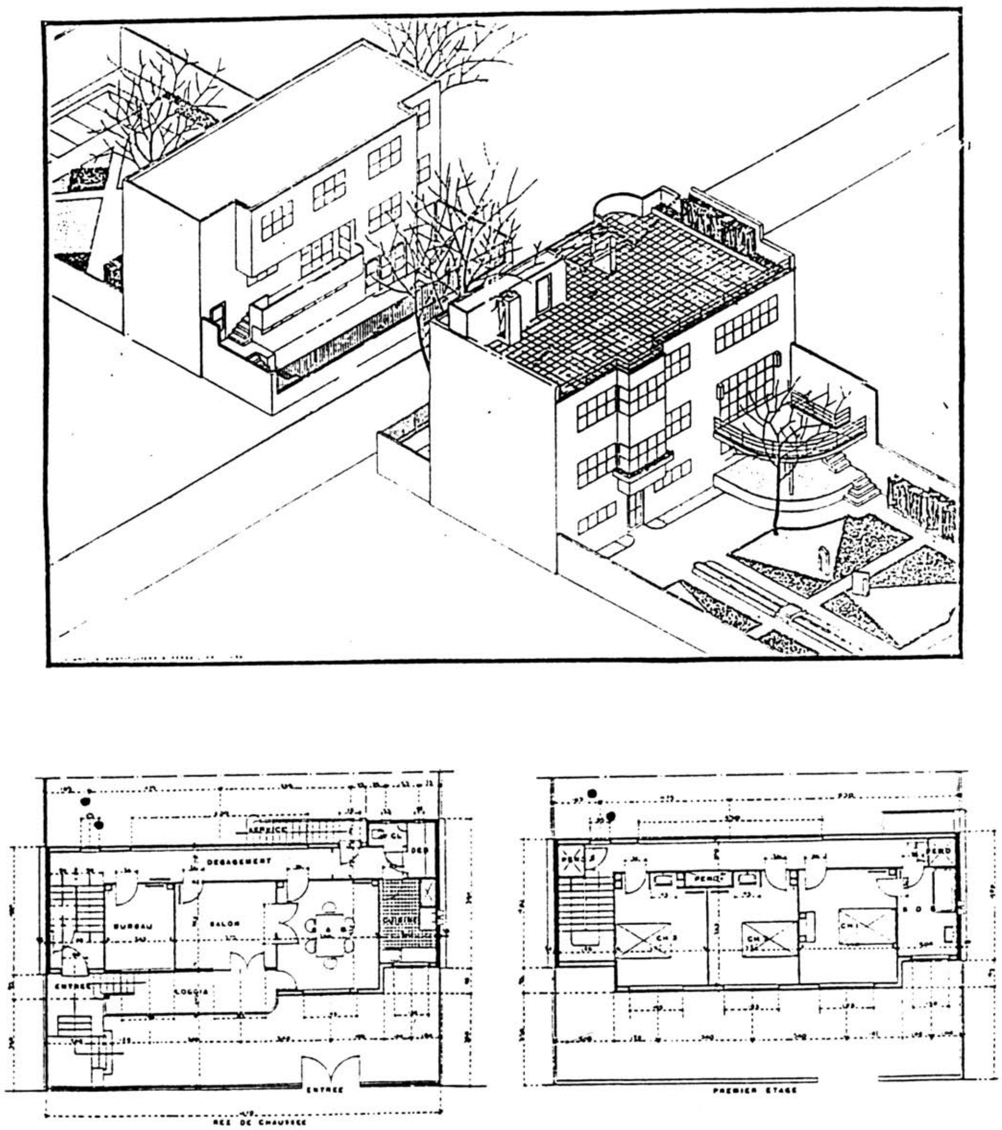


Fig.90. André Lurçat
Villa Michel: bird's-eye view and plans, 1925-1926
Source: Ragot, "Le Mouvement Moderne 1922-1933: Exigences et Compromis," vol.3, p.468.

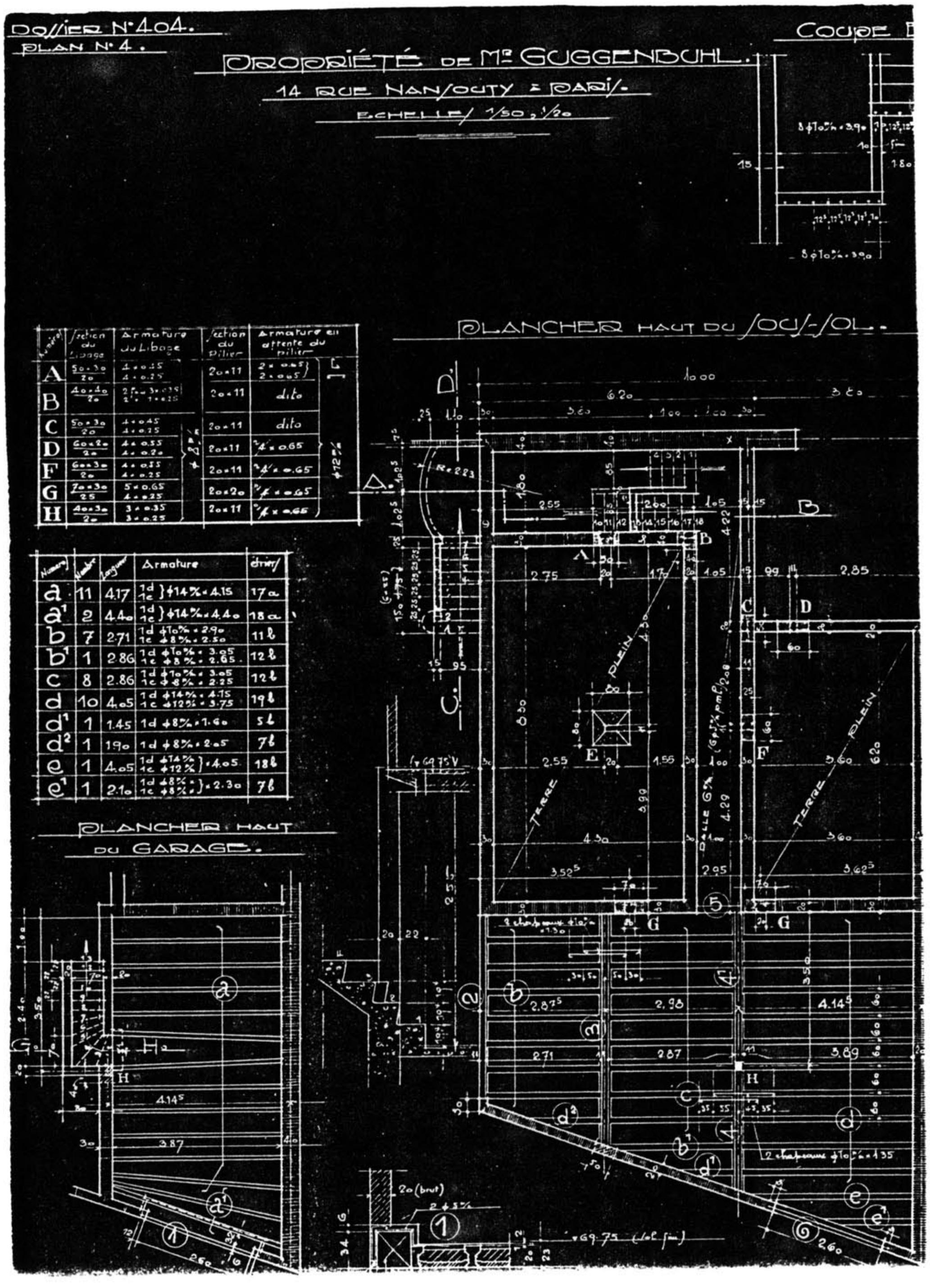
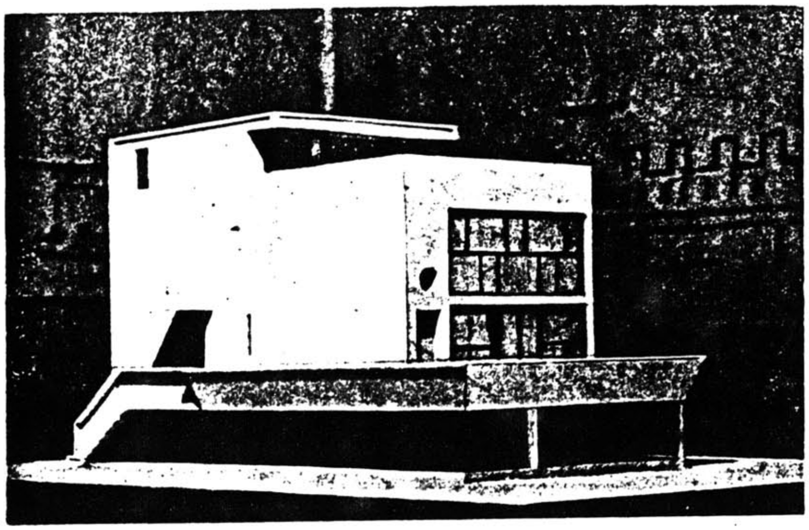
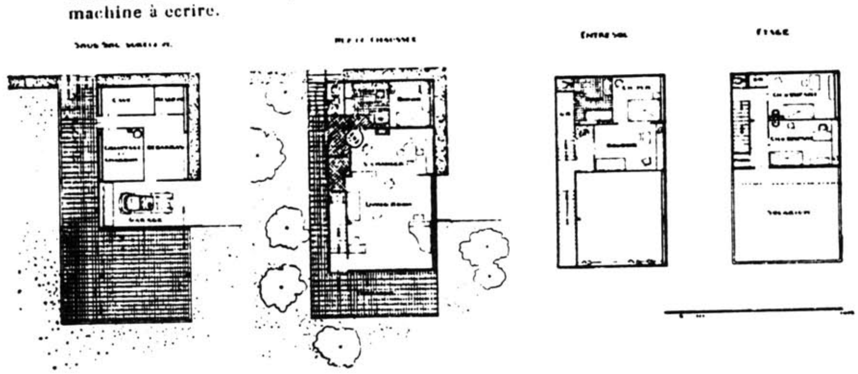


Fig.91. André Lurçat
Villa Guggenbühl: working drawings for foundation and basement floor, 1926-1927
Source: Fonds Lurçat



de l'industrie ; on modifie totalement son état d'esprit. La beauté ? Il y en a toujours lorsqu'il en existe l'intention et les moyens *qui sont la proportion* ; la proportion ne coûte rien au propriétaire, mais seulement à l'architecte. Le cœur ne sera touché que si la raison est satisfaite et celle-ci peut l'être quand les choses sont calculées. Il ne faut pas avoir honte d'habiter une maison sans comble pointu, de posséder des murs lisses comme des feuilles de tôle, des fenêtres semblables aux châssis des usines. Mais ce dont on peut être fier, c'est d'avoir une maison pratique comme sa machine à écrire.



L. C., 1921. Maison « Citrohan ». Ossature en fermes de béton coulées à pied d'œuvre et dressées au treuil. Murs en membranes de 3 centimètres en ciment projeté sur tôle déployée laissant un vide de 20 centimètres ; les dalles des planchers sur le même module ; des lignées de châssis de fenêtres d'usine avec guichets utiles sur le même module. La disposition des lieux, conforme à l'exploitation d'un ménage ; l'éclairage abondant conforme à la destination des pièces ; les nécessités d'hygiène favorisées, les domestiques soignés avec respect.

Fig.92. Le Corbusier
Maison Citrohan II: view of model and plans, 1923
Source: Le Corbusier, Vers un architecture, (Paris: Crès, 1923), 201.

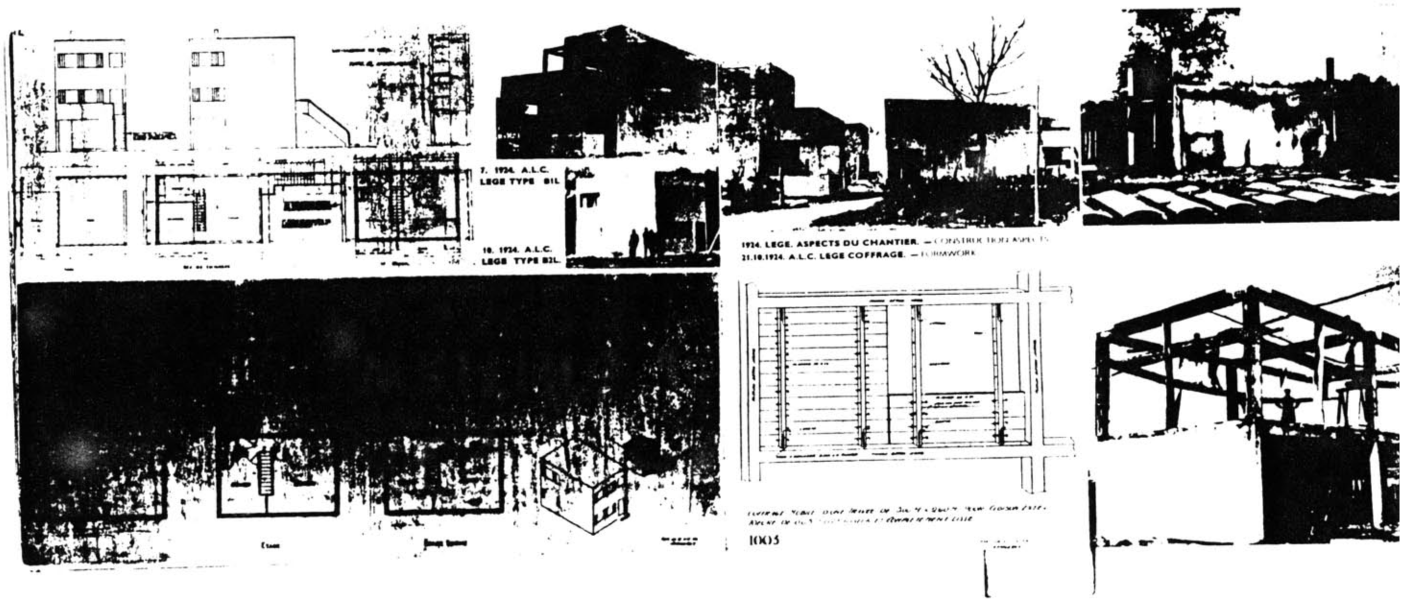


Fig.93. Le Corbusier
Lège Housing Development:drawings and view of the building site, 1924
Source: Brian Brace Taylor, Le Corbusier at Pessac, (ex. cat. Cambridge-Paris: Harvard University and Fondation Le Corbusier, 1972), n.p.

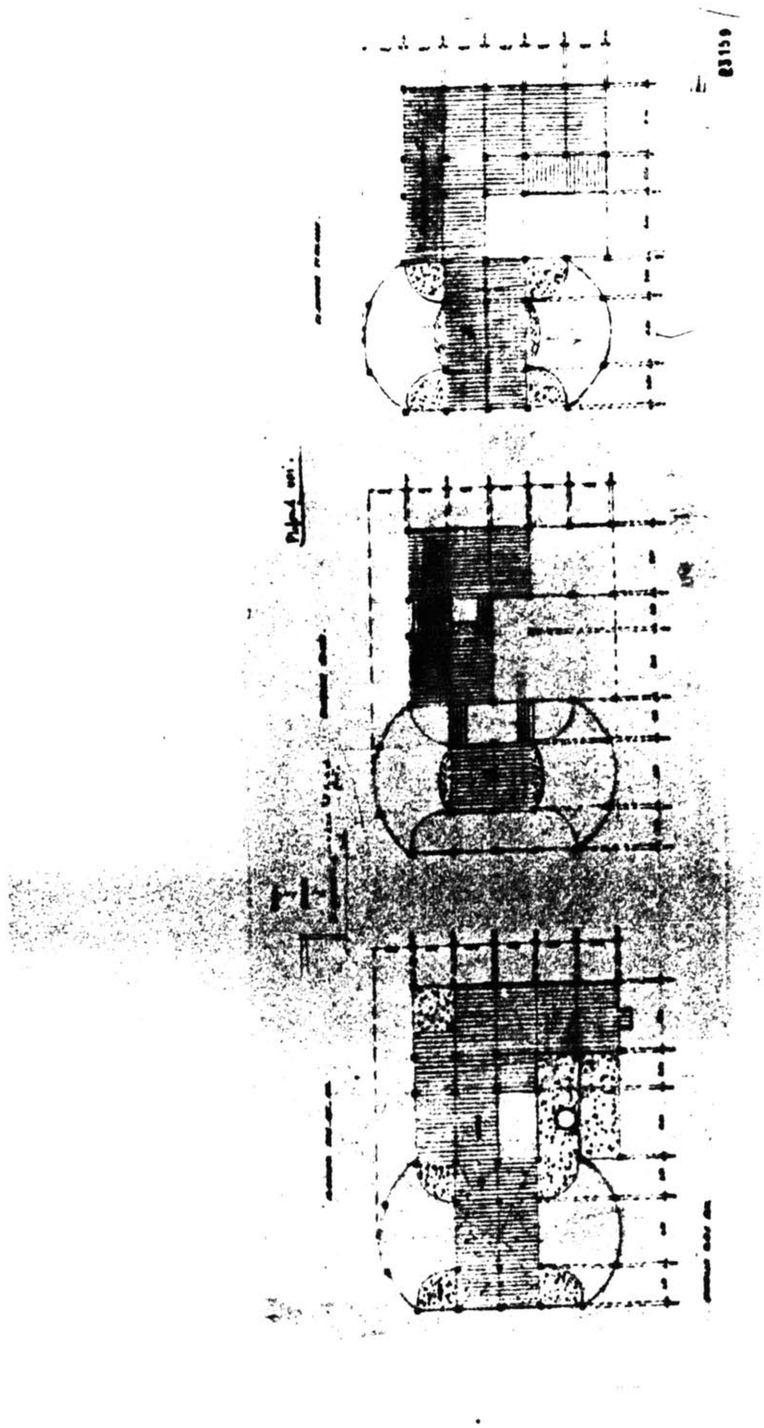


Fig.94. Le Corbusier
Pavillon Esprit Nouveau: structural plans, 1925
Source: Le Corbusier Archive, vol.2, p.190.

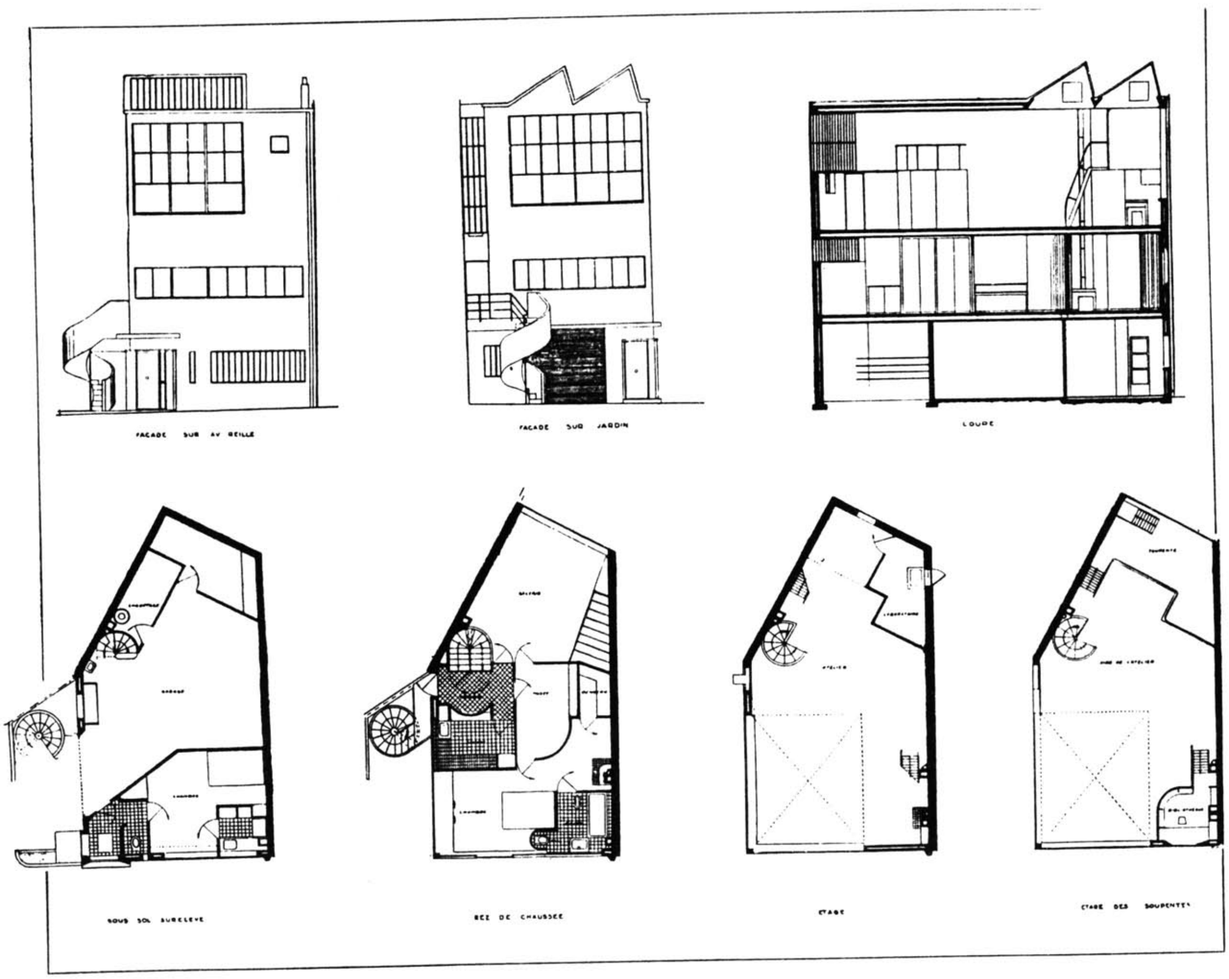


Fig.95. Le Corbusier
Atelier Ozenfant: plans, elevations, and section, 1922
Source: Le Corbusier Archive, vol.2, p.432.

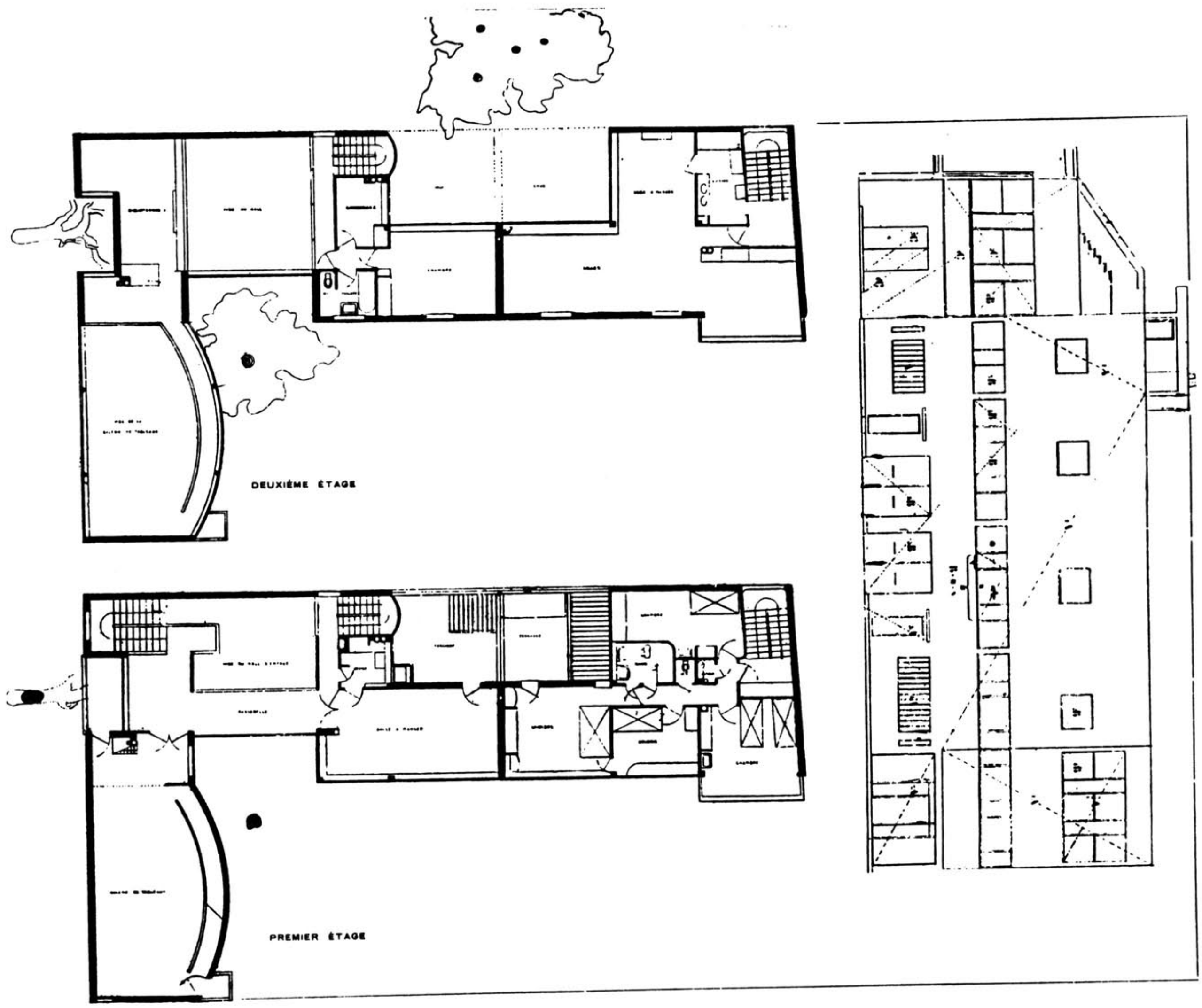


Fig.96. Le Corbusier
Villa La Roche-Jeanneret: plans, 1923
Source: L'Architecture Vivante vol.4 (Fall-Winter 1926), p.11.

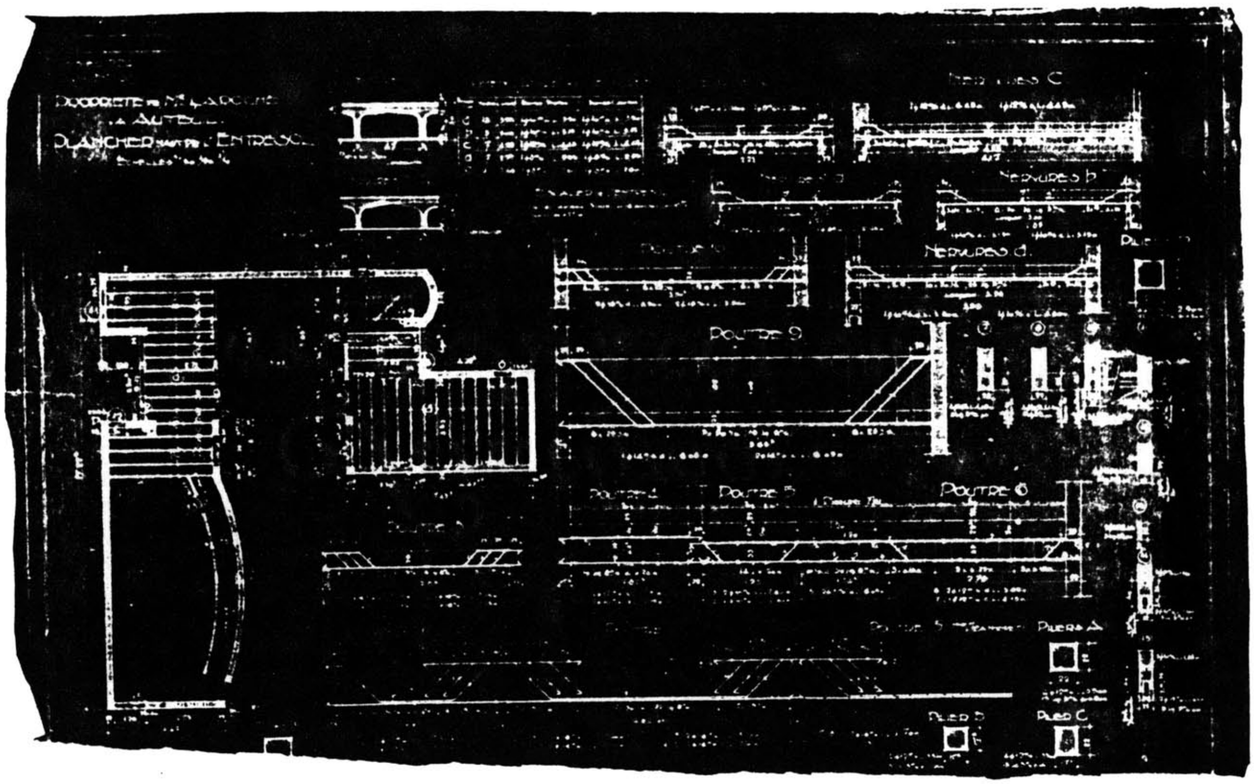


Fig.97. Le Corbusier
Villa La Roche-Jeanneret: working drawing for reinforced structure for gallery wing, 1923
Source: Le Corbusier Archive, vol.2, p.574.

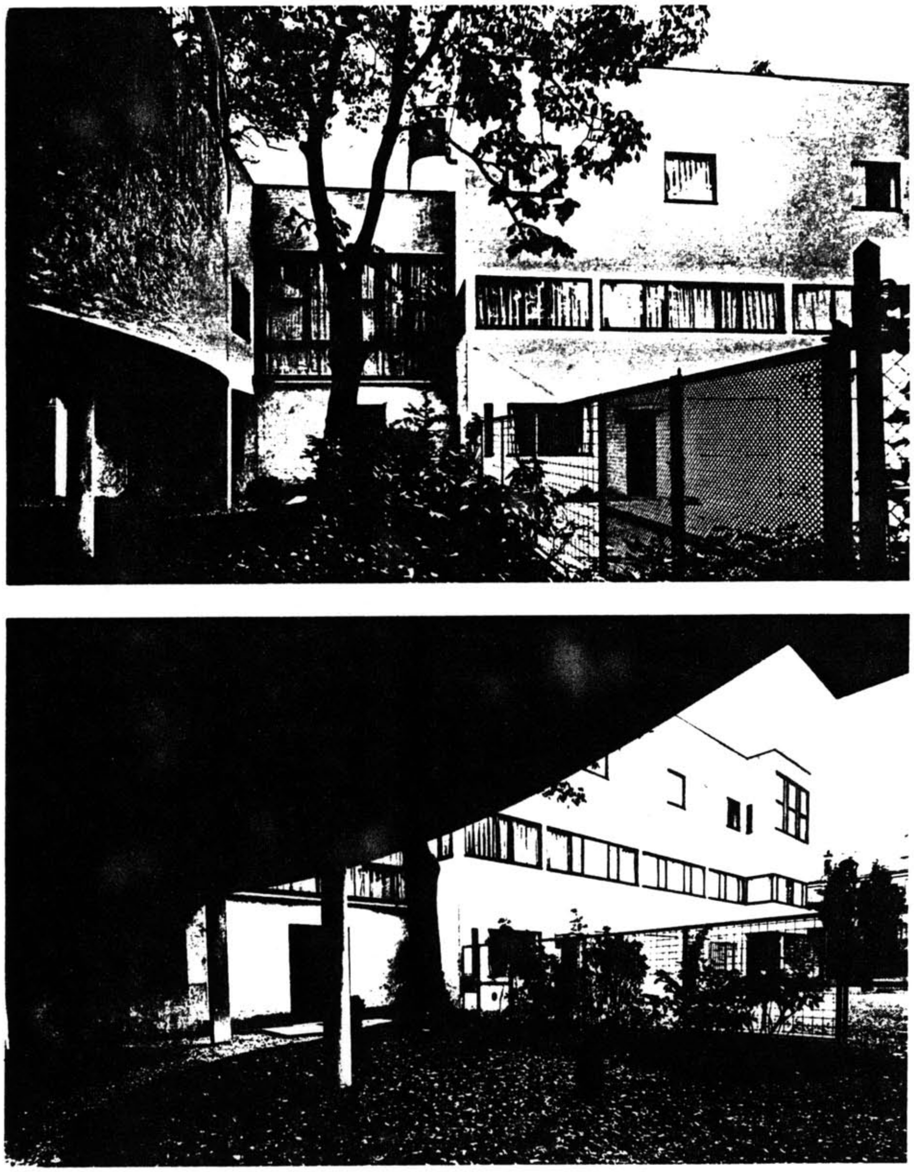


Fig.98. Le Corbusier
Villa La Roche-Jeanneret: exterior views, 1926
Source: L'Architecture Vivante vol.4 (Fall-Winter 1926), pl.14.

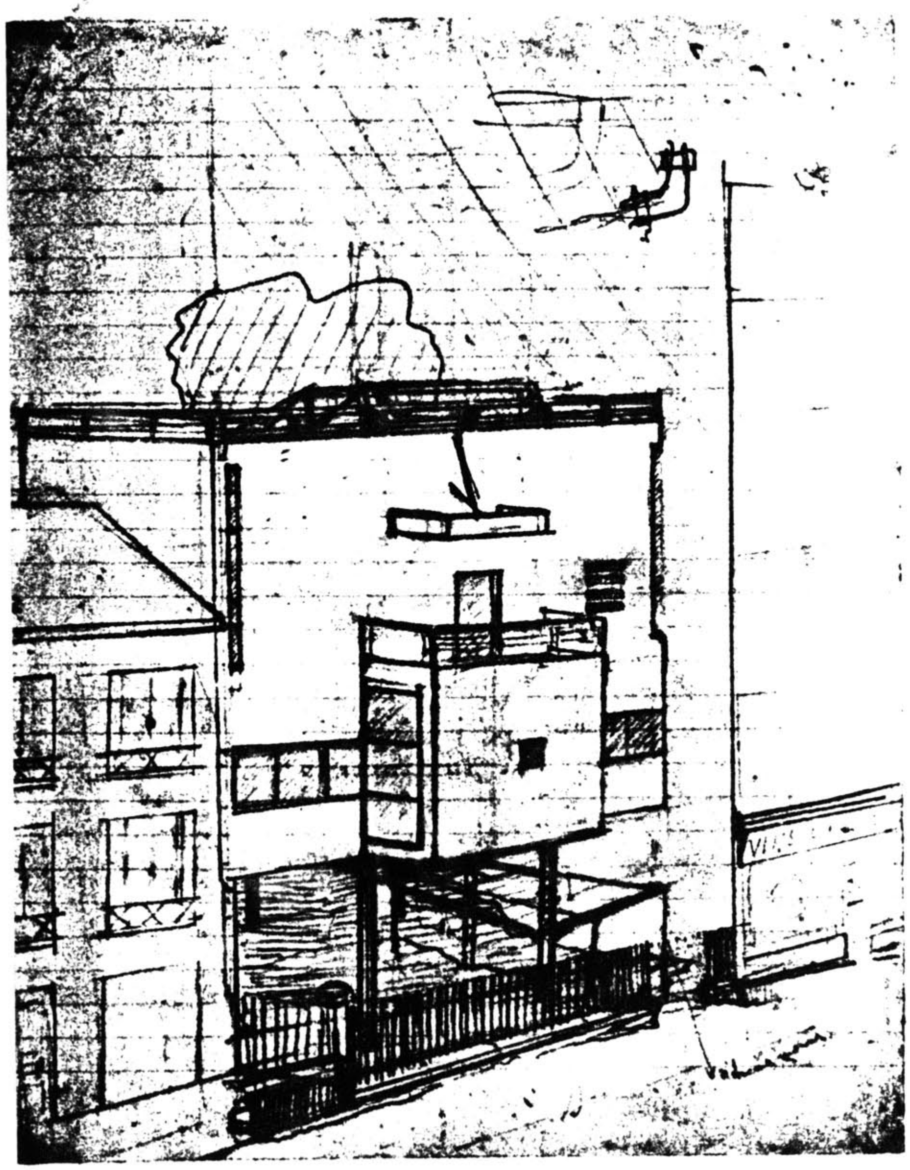


Fig.99. Le Corbusier
Maison Planeix: perspective sketch, 1927
Source: Le Corbusier Archive, vol.3, p.505.

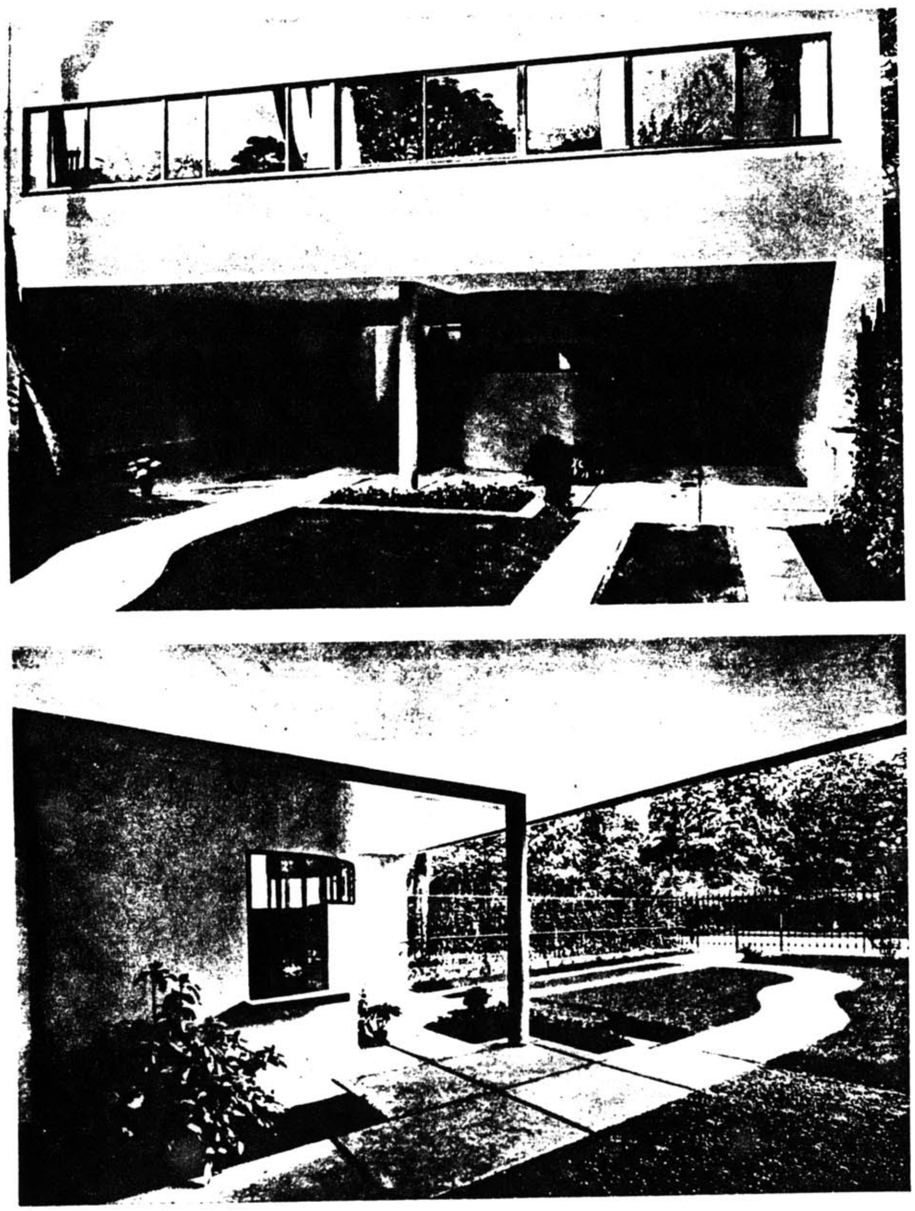


Fig.100. Le Corbusier
Maison Cook: views of entrance and garage, 1927
Source: L'Architecture Vivante vol.5 (Fall-Winter 1927), pl.3.

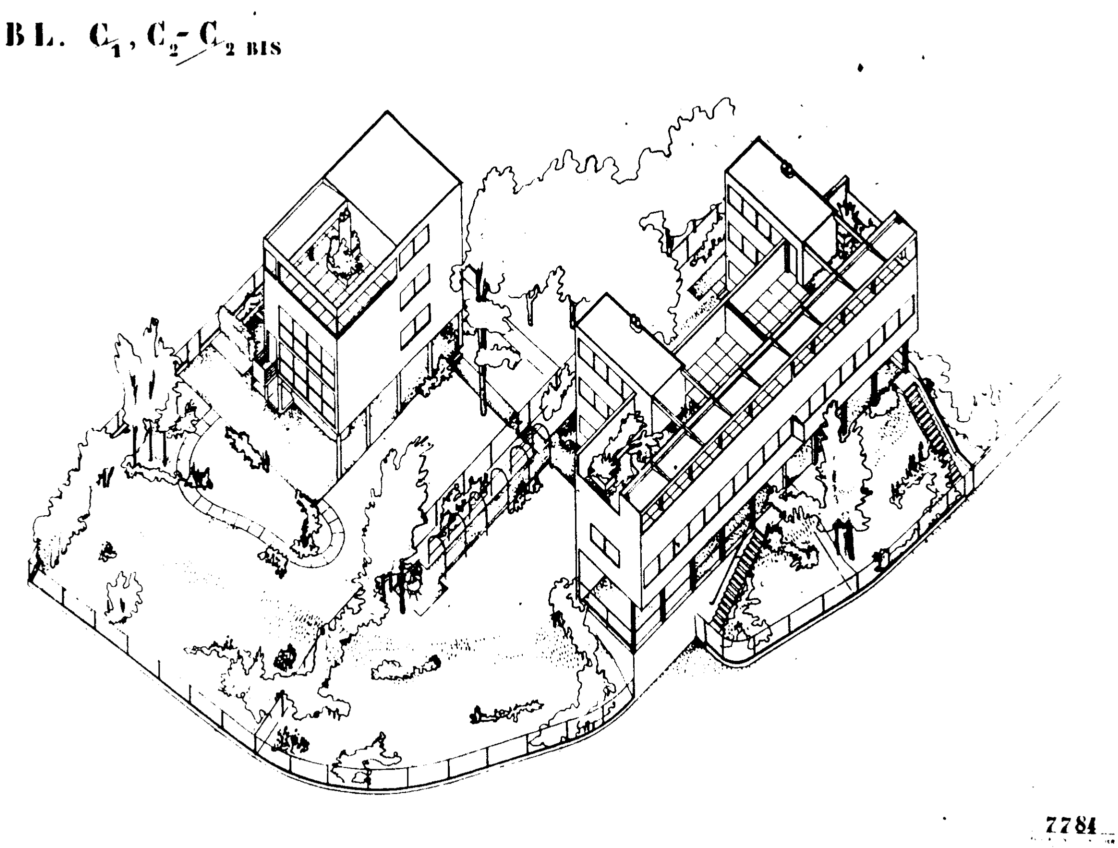


Fig.101. Le Corbusier
Weissenhofsiedlung, Stuttgart: axonometric for two houses, 1927
Source: Le Corbusier Archive, vol.3, p.223.

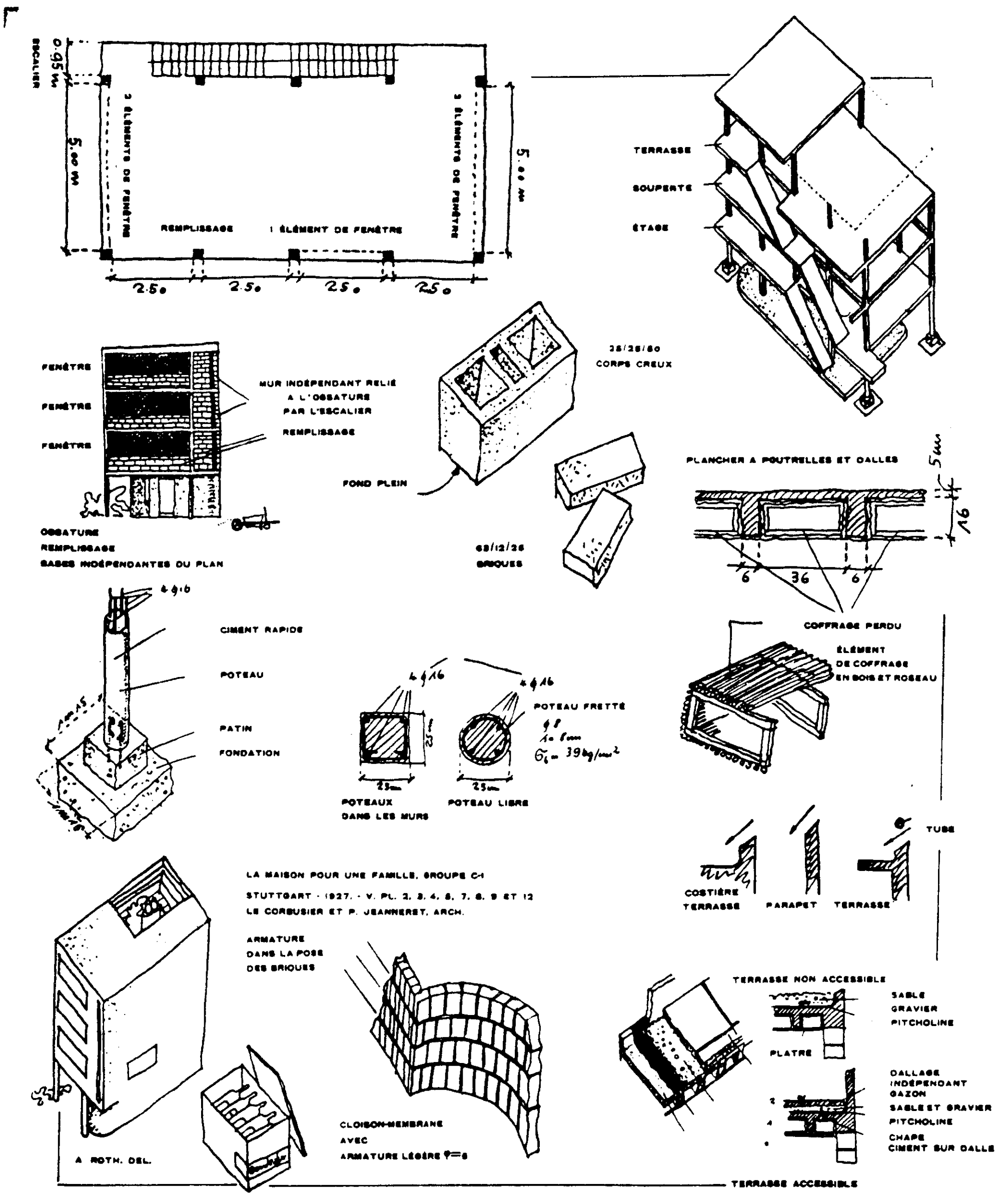


Fig.102. Le Corbusier
Weissenhofsiedlung, Stuttgart: diagrams illustrating the construction system of the single family house, 1927
Source: L'Architecture Vivante vol.6 (Spring-Summer 1928), pl.13.

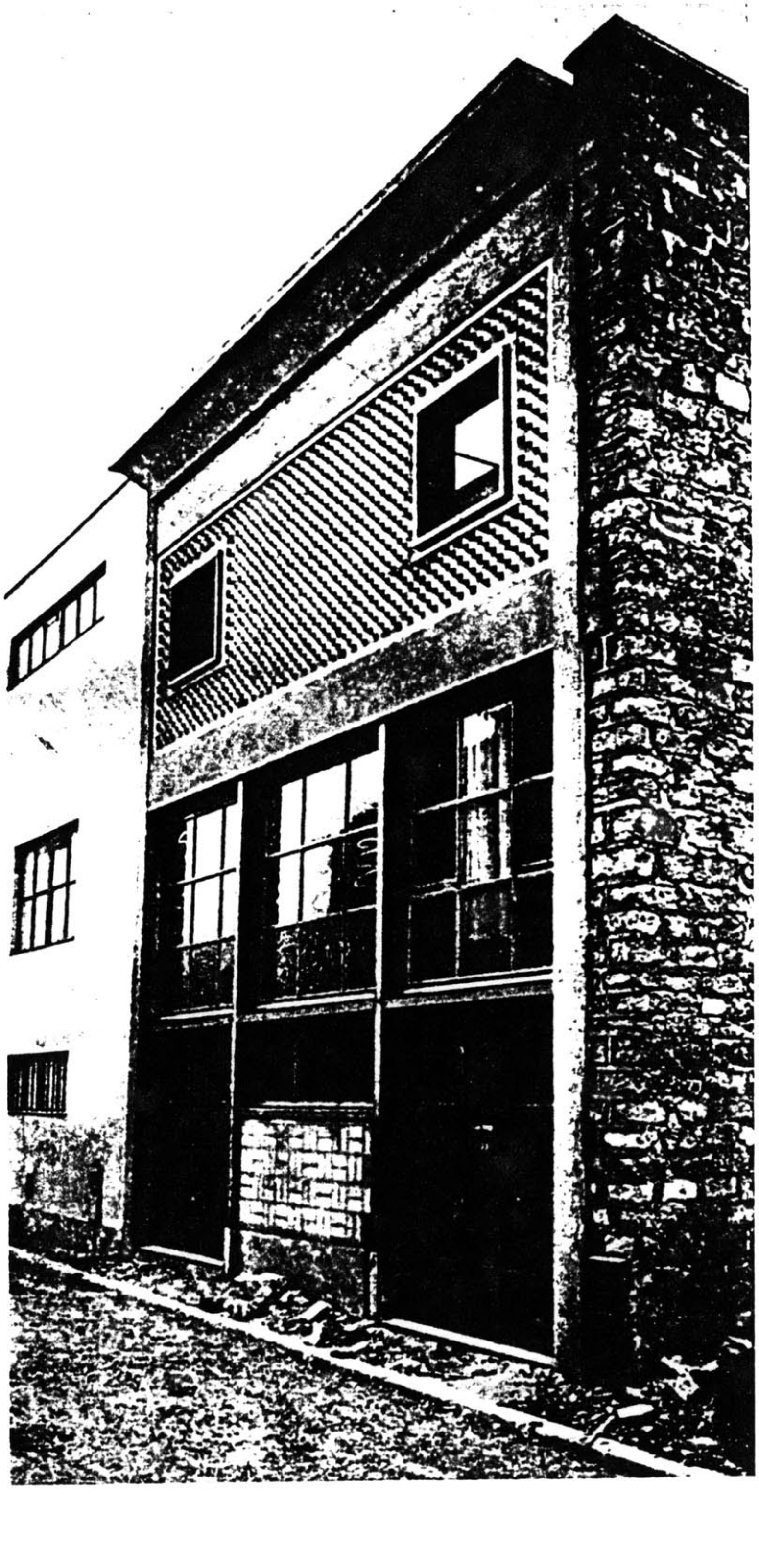


Fig.103. Auguste and Gustave Perret
Atelier Chana Orloff, 1926-1927
Source: Fonds Perret

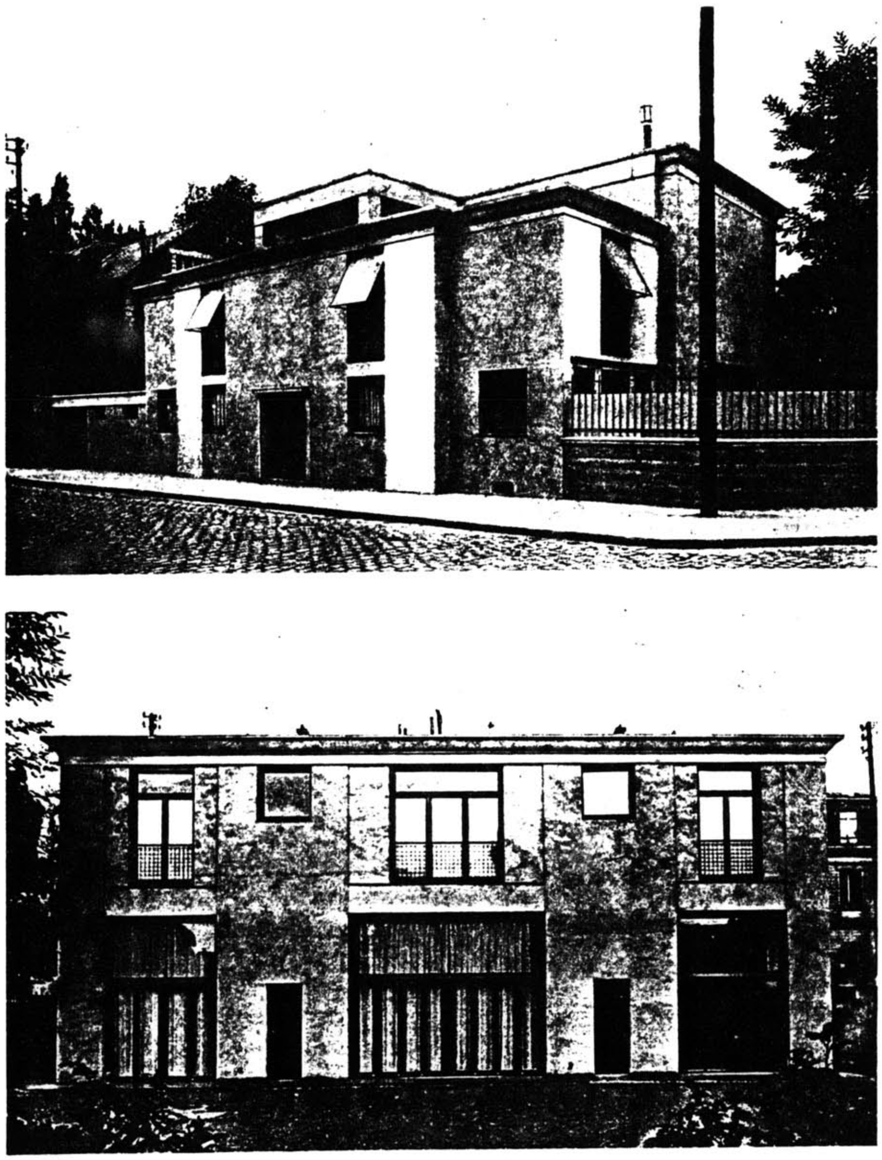


Fig.104. Auguste and Gustave Perret
Maison Mouron, Garches, 1926
Source: L'Architecture Vivante vol.4 (Fall-Winter 1926), pl.10.

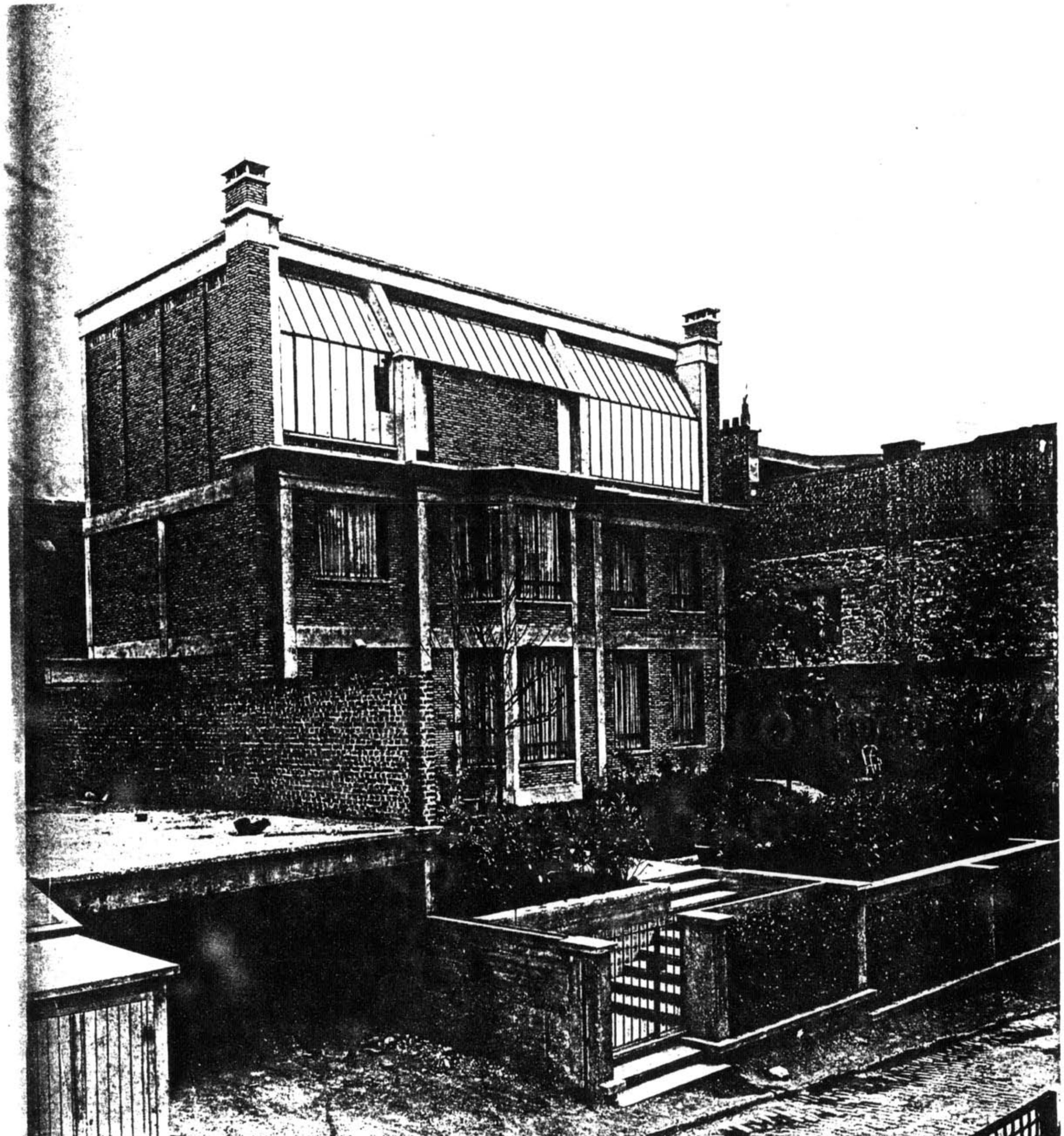


Fig.105. Auguste and Gustave Perret
Maison Georges Braque, 1927
Source: Fonds Perret

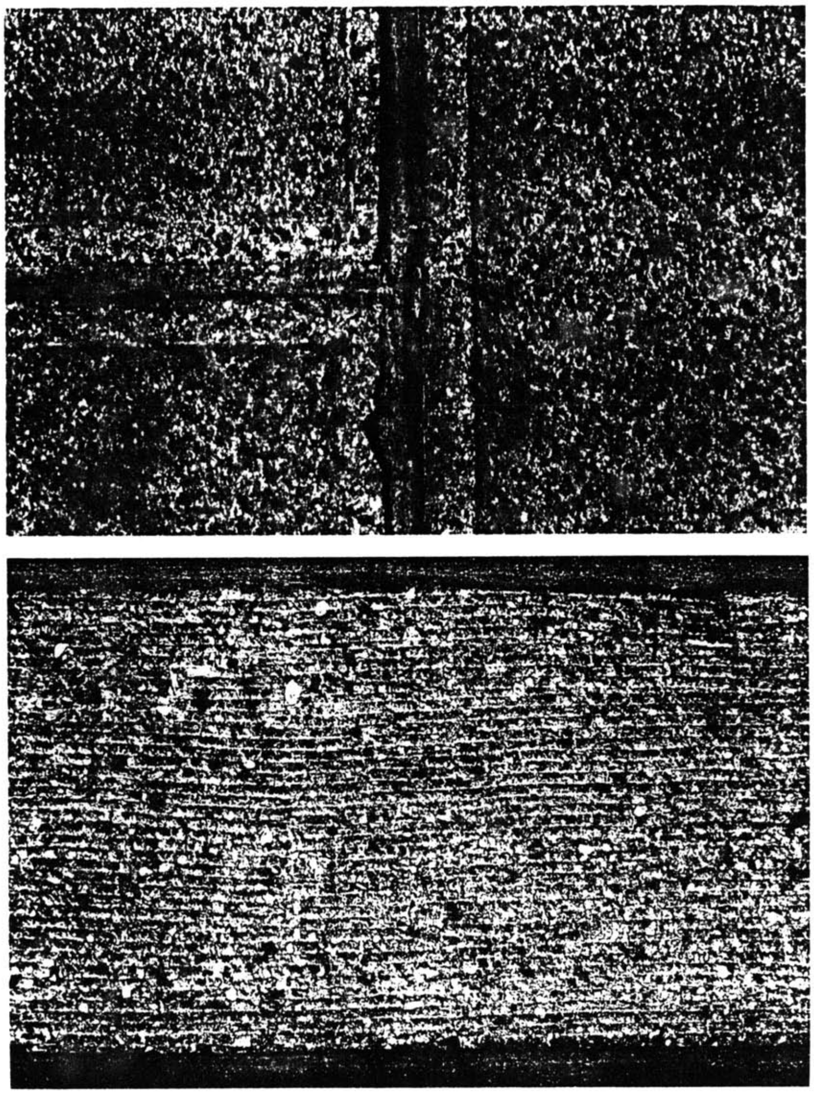


Fig.106. Auguste and Gustave Perret
Examples of bush-hammered concrete surfaces
Source: Gargiani, Auguste Perret 1874-1954. Teoria e opere, p.195

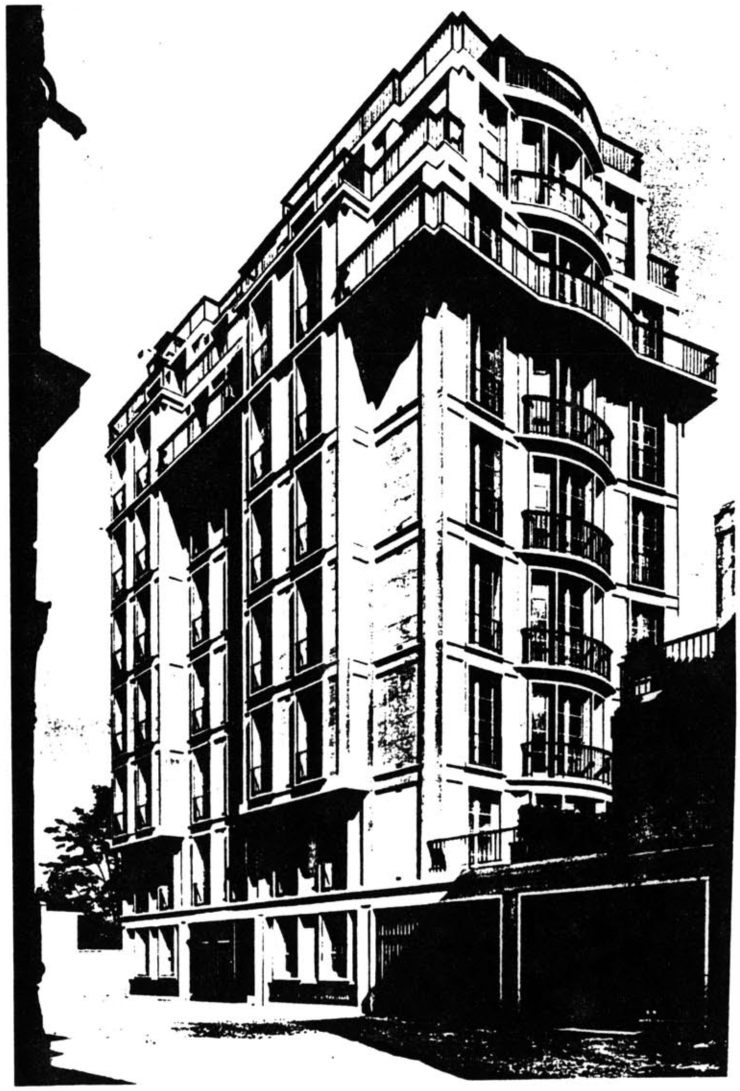


Fig.107. Auguste and Gustave Perret
Residential and office building, rue Raynouard, 1928-1930
Source: Fonds Perret

Fig.108. Auguste and Gustave Perret
Service technique des constructions navales, 1928-1931
Source: Fonds Perret

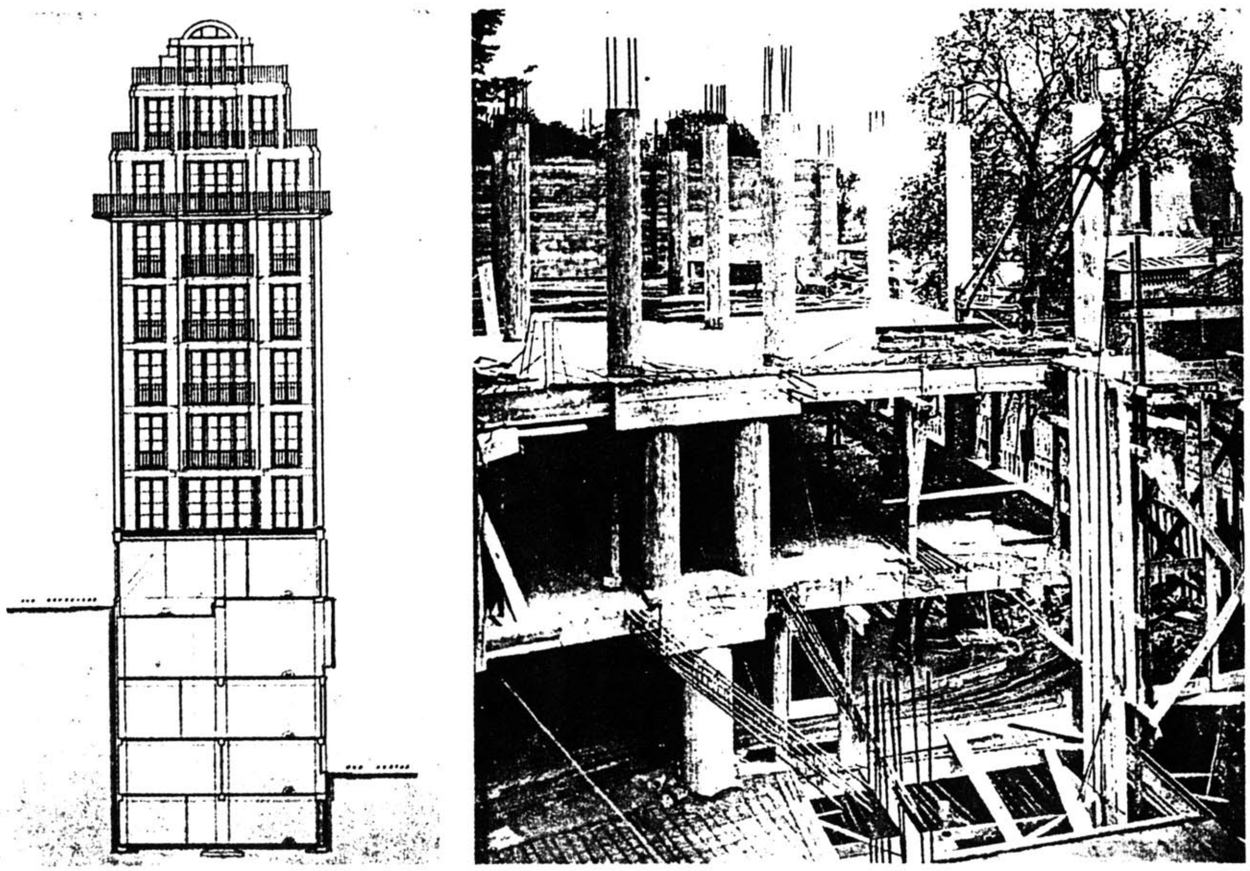


Fig.109. Auguste and Gustave Perret
Residential and office building, rue Raynouard: sectional elevation showing reinforced concrete structure; view of building during construction, 1928-1930
Source: Fonds Perret

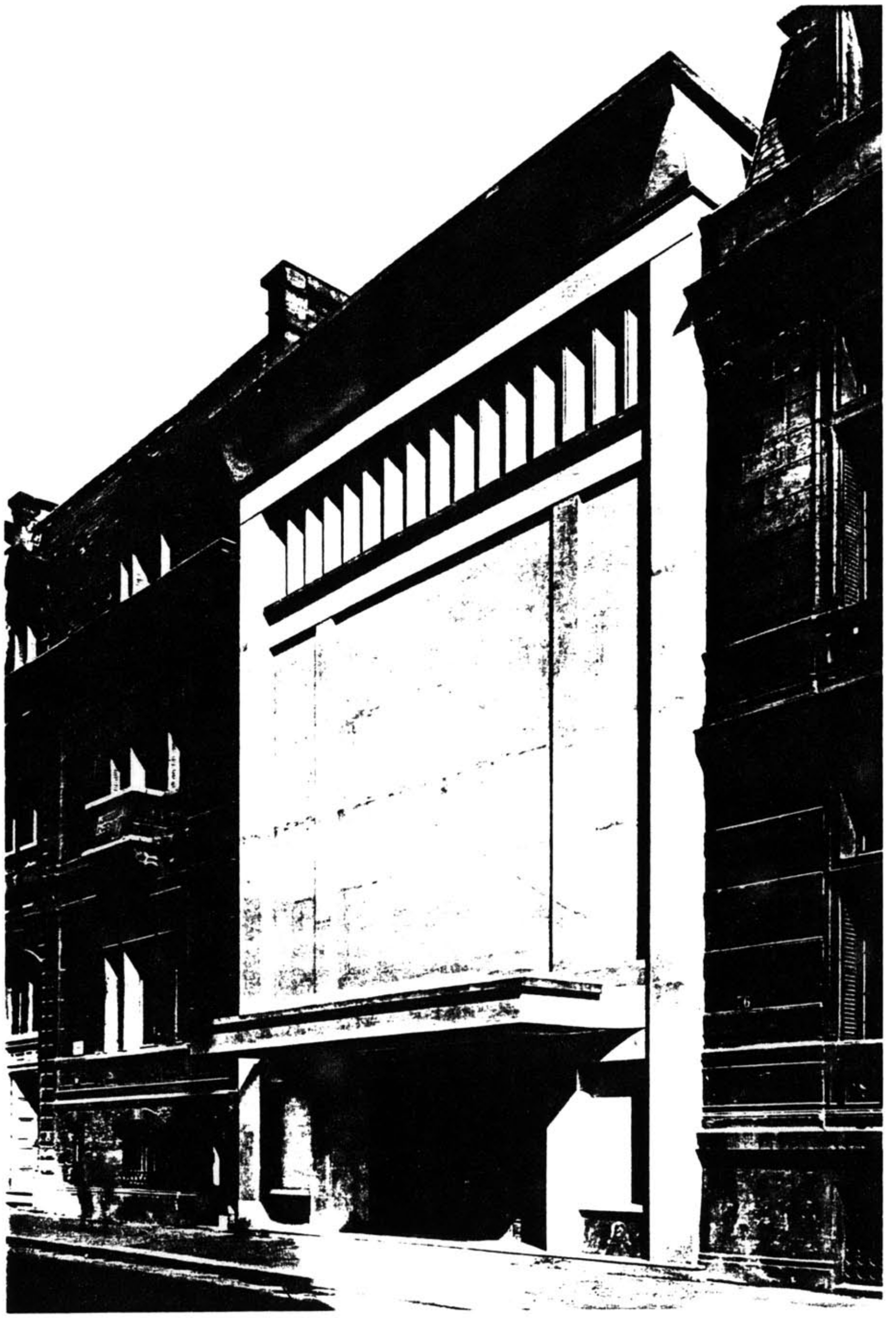


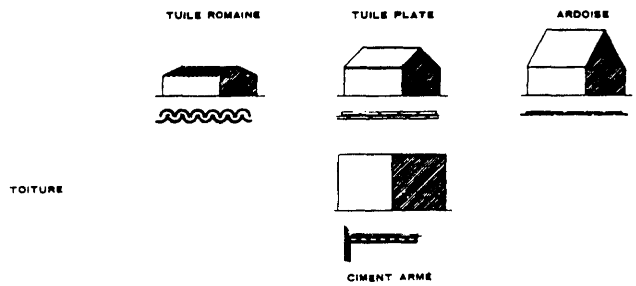
Fig.110. Auguste and Gustave Perret
Salle Cortot, 1928-1929
Source: Fonts Perret

Et si l'on considère la question en urbaniste, on s'apercevra que l'on a reconquis l'entière surface de la ville, en haut, à la place des toits: au mètre carré, cela fait un joli capital.

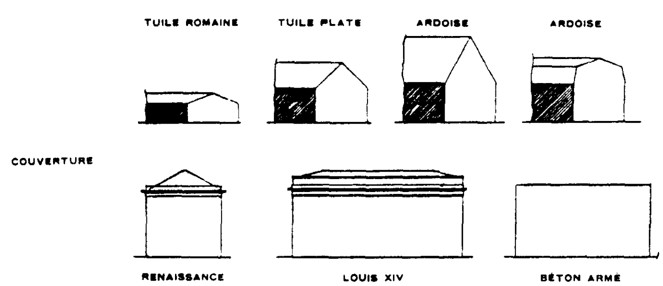
Y a-t-il encore quelqu'un pour plaider en faveur du comble incliné du « bon vieux toit » de toujours ?

Nous croyons pouvoir affirmer que, pour la première fois, a été énoncée la théorie du toit plat. Elle est la conséquence d'expériences parfois cruelles (1911-1927.)

(Réponse à l'enquête organisée en 1926 par Walter Gropius et publiée dans le *Bauwelt*, avril 1926.)



La couverture étanche fixe la forme de la toiture. La pénurie des moyens portait entrave au rêve *constant de monter sur la maison.* Le béton armé apporte le toit plat et révolutionne l'usage de la maison.

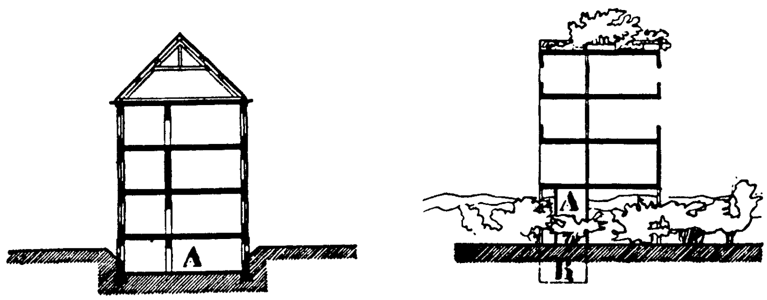


La tendance de l'esprit est d'atteindre aux solutions simples. La simplicité est l'aboutissement du travail de l'esprit. On voit ici les formes fondamentales dictées par les climats et les matériaux. Ensuite les velléités d'un idéal spirituel aux prises avec des réalités constructives. Le béton armé nous dotant du toit plat nous apporte la libération des sujétions séculaires.

— 18 —

Fig.111. Le Corbusier
Théorie de toit plat: diagrams, 1926
Source: L'Architecture Vivante vol.5 (Fall-Winter 1927), p.18.

II. *LA MAISON SUR PILOTIS.* — La maison s'enfonçait dans le sol: locaux obscurs et souvent humides.

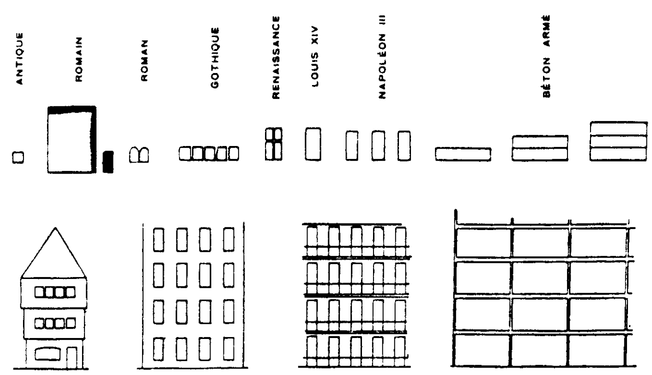


(LA CAVE EST EN A : ELLE PEUT ÊTRE AUSSI EN B)

Le ciment armé nous donne les pilotis. La maison est en l'air, loin du sol; le jardin passe sous la maison; le jardin est aussi sur la maison, sur le toit.

*
* *

III. *LA FENETRE EN LONGUEUR.* — La fenêtre fut toujours l'obstacle. Son évolution à travers les âges, marque le perfectionnement de l'outillage.



La fenêtre est l'un des buts essentiels de la maison. Le progrès apporte une libération. Le ciment armé fait révolution dans l'histoire de la fenêtre.

Fig.112. Le Corbusier
La fenetre en longeur, 1927
Source: L'Architecture Vivante vol.5 (Fall-Winter 1927), p.19.

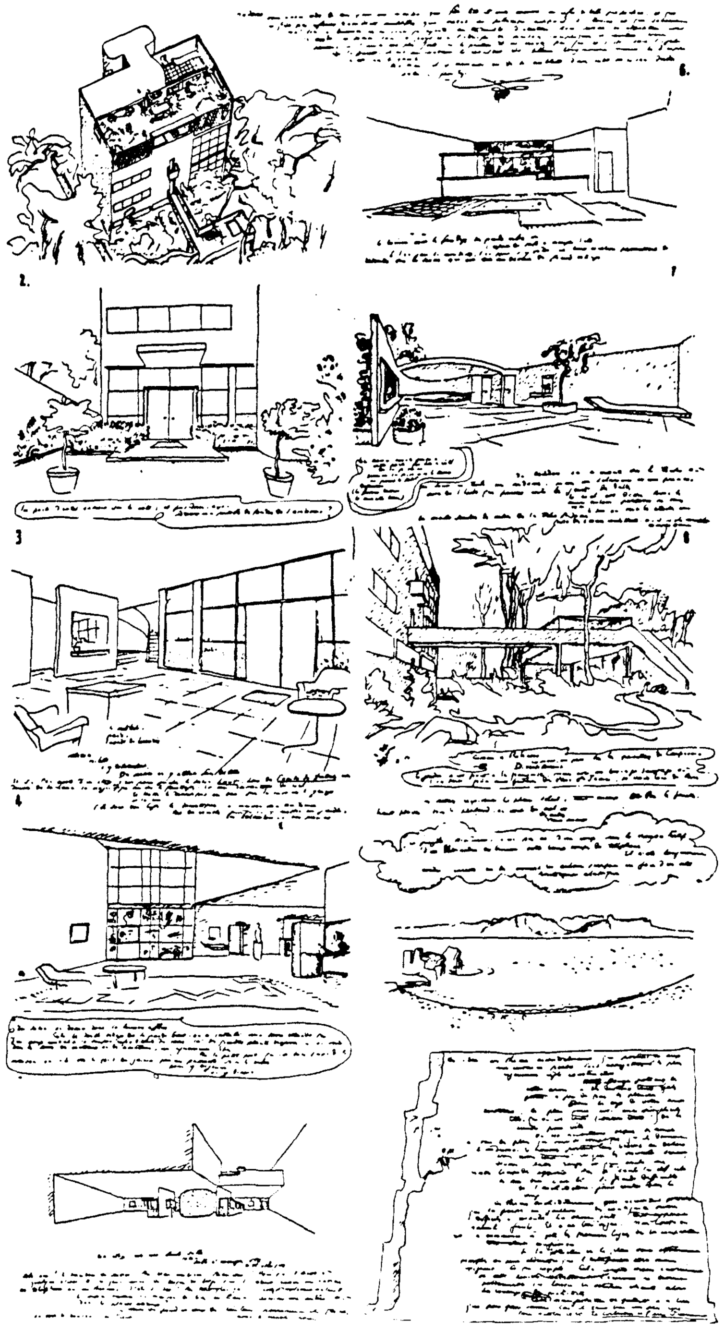


Fig.113. Le Corbusier
Letter to Mme. Meyer: sketches, October 1925
Source: Le Corbusier and Pierre Jeanneret, Oeuvre Complète de 1910-1929, p.89

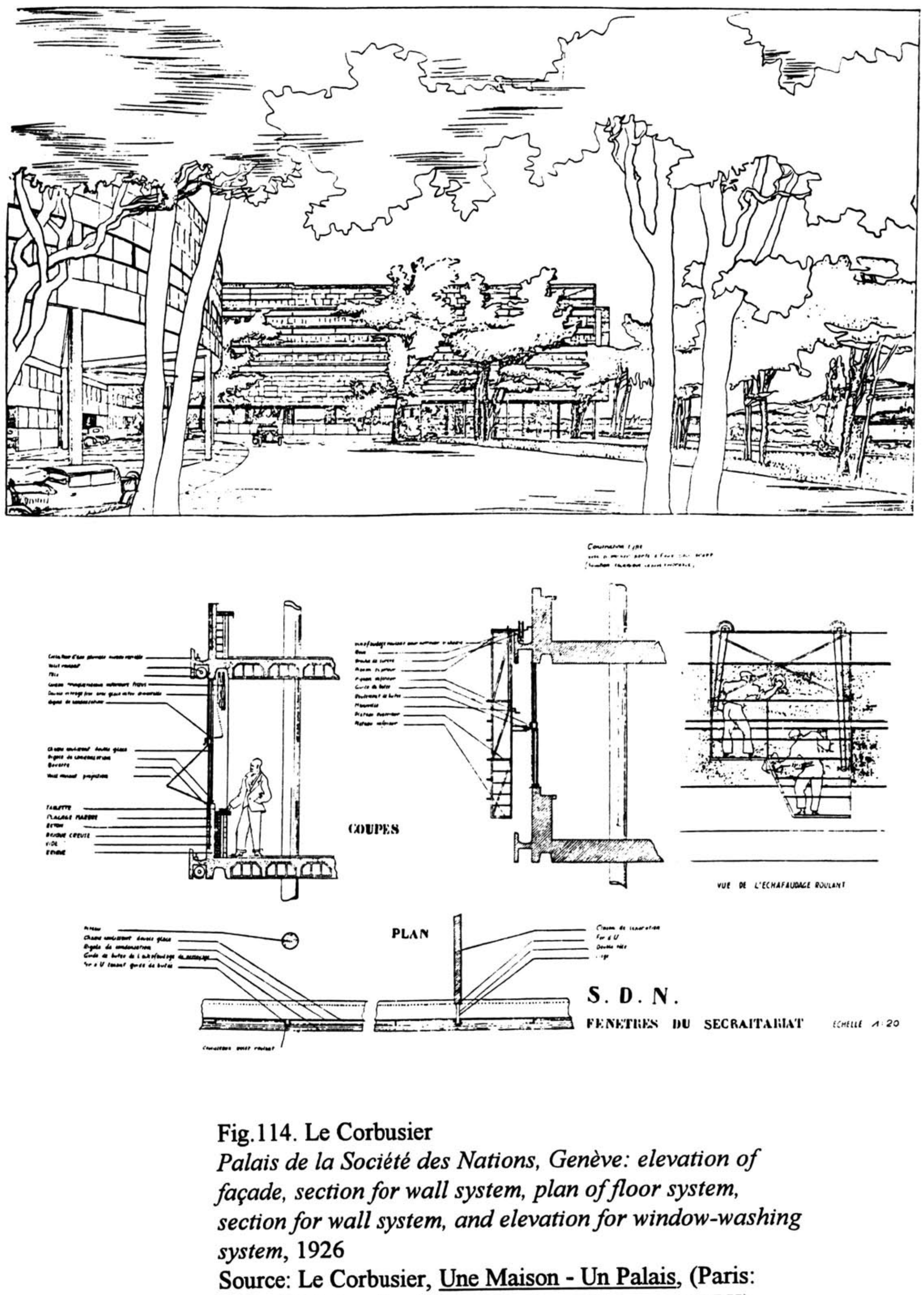


Fig.114. Le Corbusier
Palais de la Société des Nations, Genève: elevation of façade, section for wall system, plan of floor system, section for wall system, and elevation for window-washing system, 1926
Source: Le Corbusier, Une Maison - Un Palais, (Paris: Crès, 1928 [reprint, Torino: Bottega d'Erasmo, 1975]), pp.102-103.

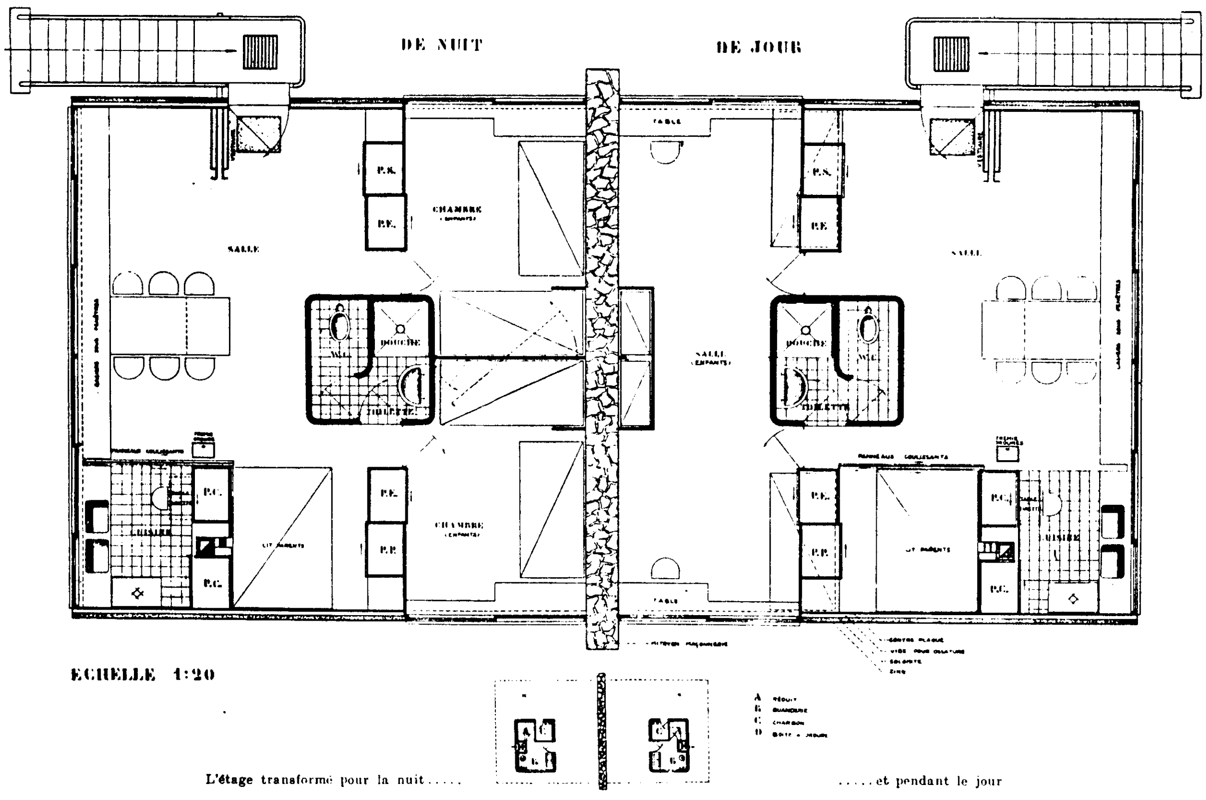


Fig.115. Le Corbusier
Maisons Loucheur: plans, 1929
Source: Le Corbusier and Pierre Jeanneret, Oeuvre Complète de 1910-1929, p.198.

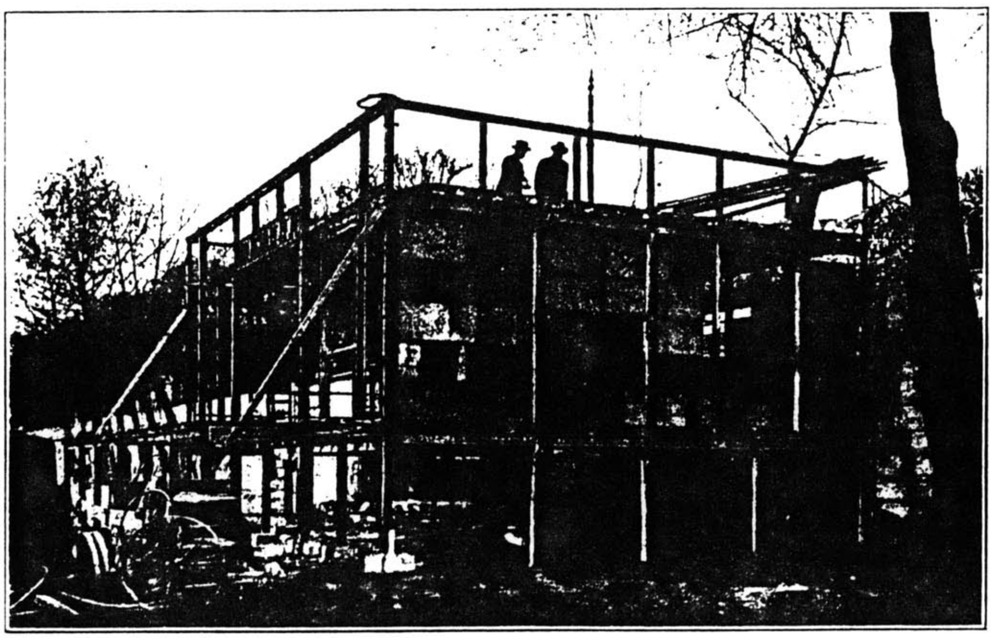
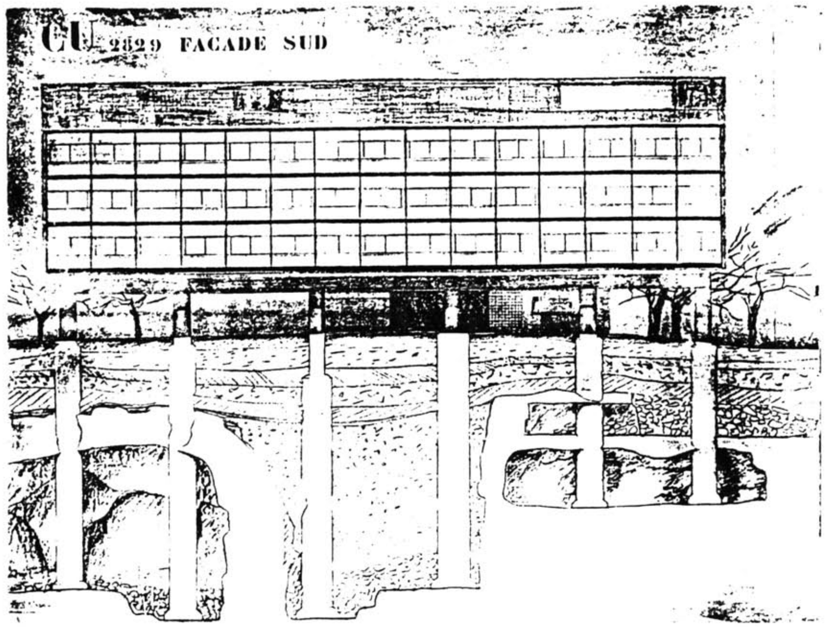


Fig.116. Raoul Decourt
Maison Isotherme: view during construction, 1925
Source: La Science et la Vie, vol.27, no.99 (September 1925), p.230.



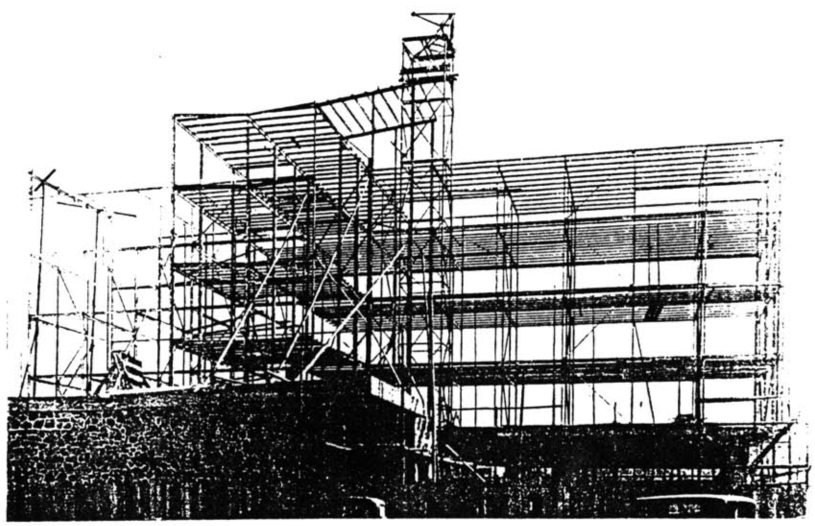
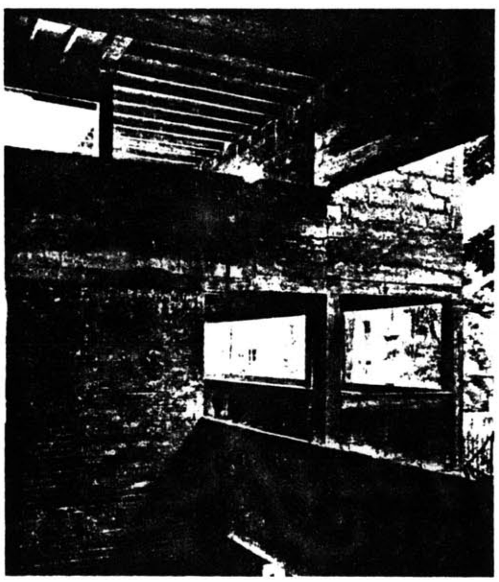


Fig.117. Le Corbusier
Pavillon Suisse: elevation with section for foundation, view during construction, 1933
Source: Chantiers, vol.1, no.1 (January-February 1933), p.4.



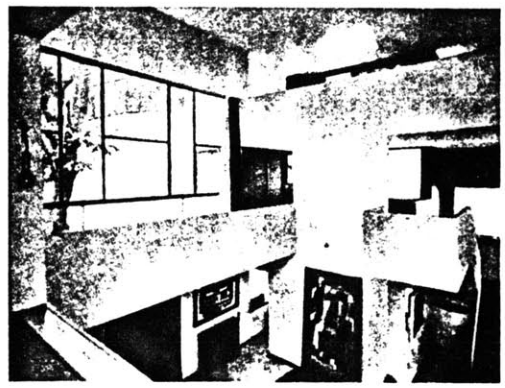


Fig.118. Le Corbusier
Villa La Roche-Jeanneret: views during and after construction
Source: Sigfried Giedion, Bauen in Frankreich, (Leipzig: Klinkhardt & Biermann, 1928), 178.

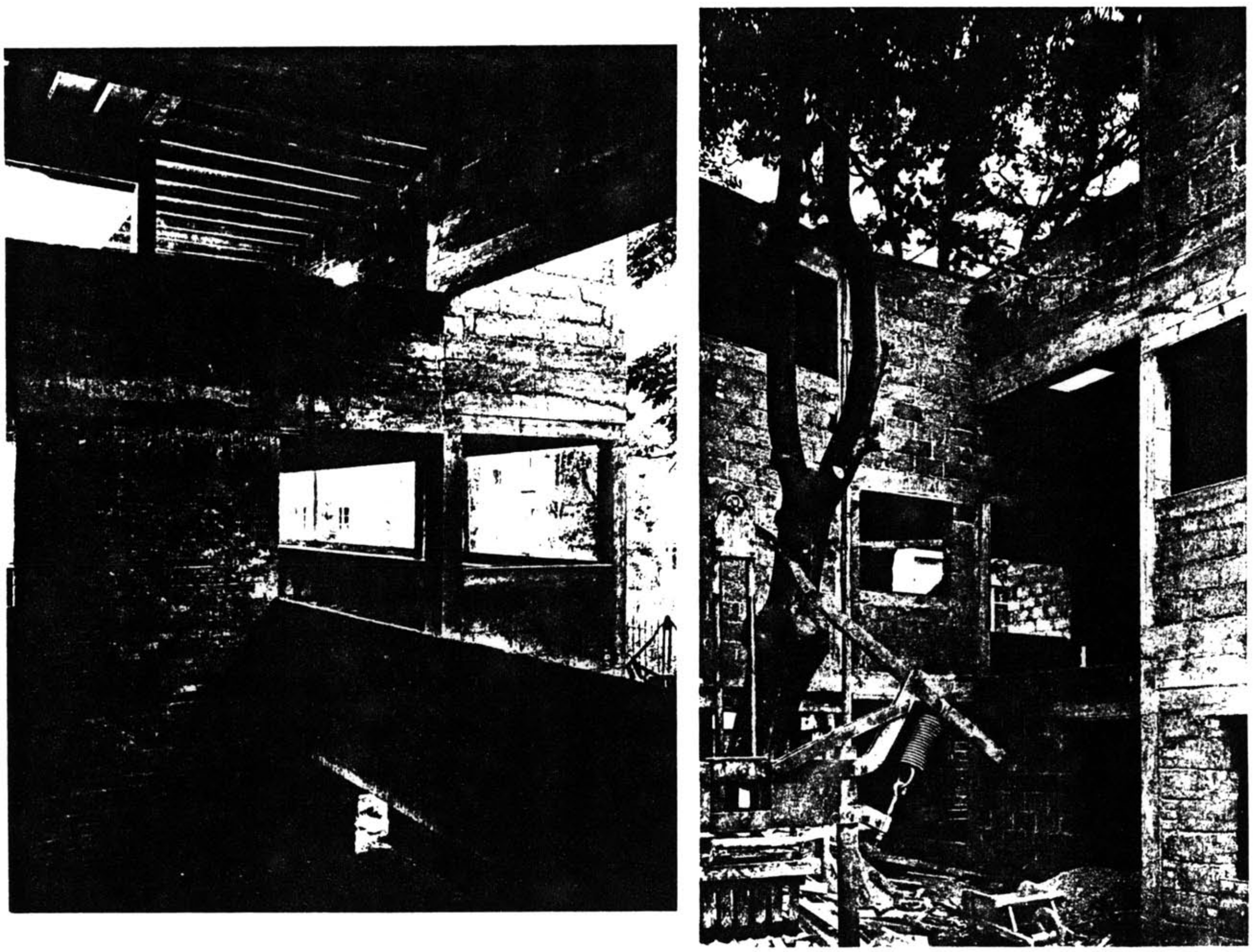
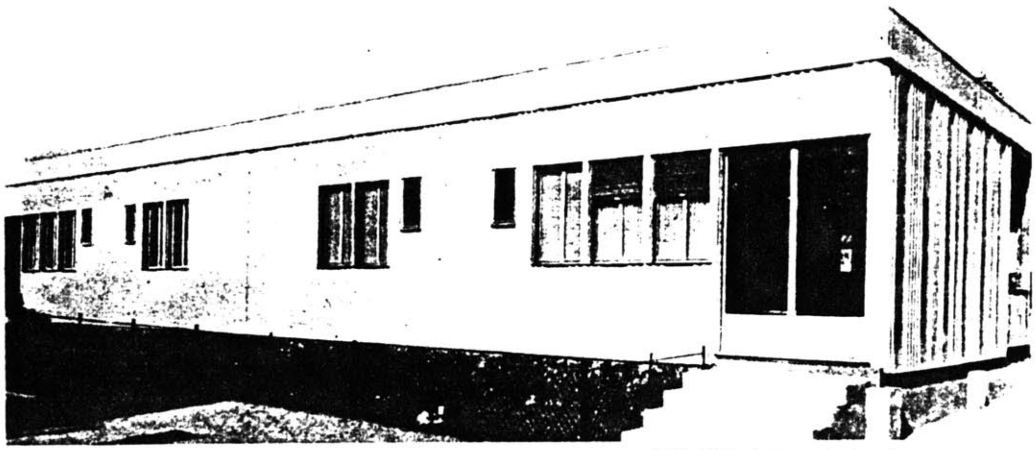


Fig.119. Le Corbusier
Villa La Roche-Jeanneret: views during construction, 1925
Source: L'Architecture Vivante vol.4 (Fall-Winter 1926), pl.15.



Andrien BRELET, André LEDONNE, Oscar NITZCHKE Maisons metalliques 1928-1929 Archives Ledonné

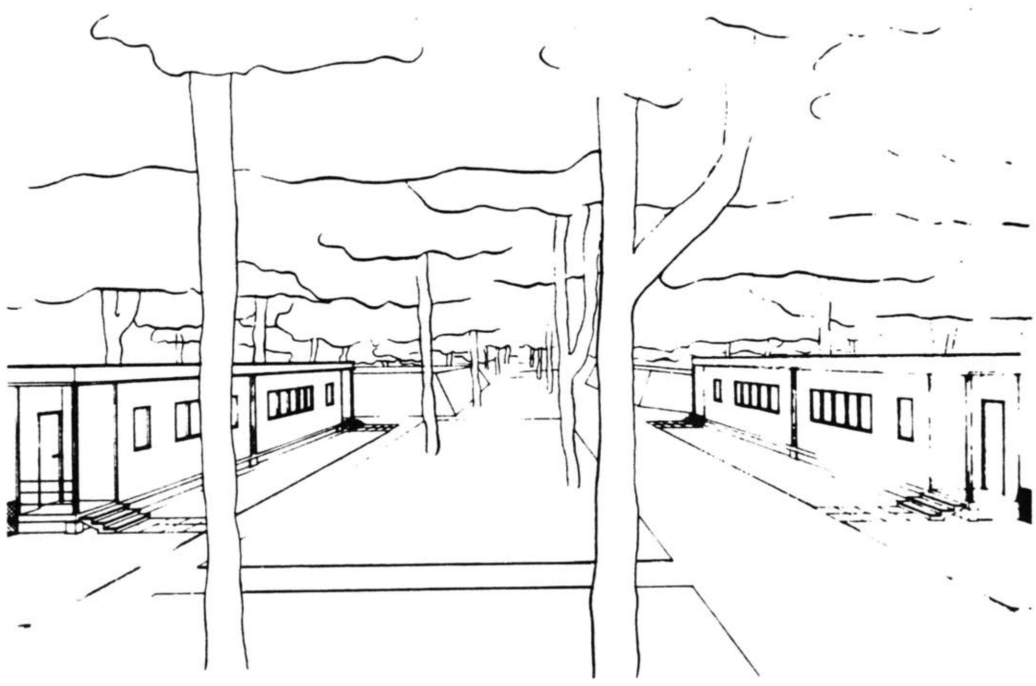


Fig.120. André Ledonné, Adrien Brelet, Oscar Nitzchké
Maison métallique: view of completed structure and perspective, 1928-1929
Source: Archives Ledonné, in "Les Premiers Eleves de Perret", Bulletin d"Informations Architecturales, no.91 (January 1985), p.7.

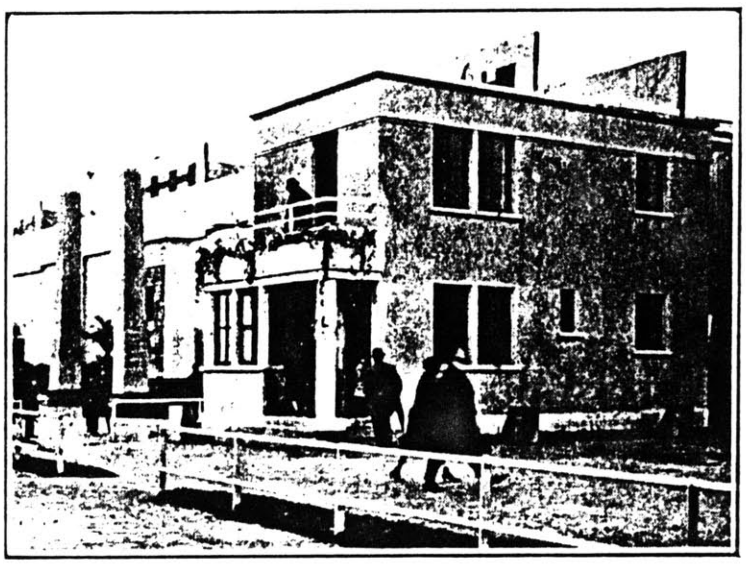


Fig.121. Urbain Cassan
Maison type Loi Loucheur, 1929
Source: Le bâtiment illustré no.2 (February 1931), p.23.

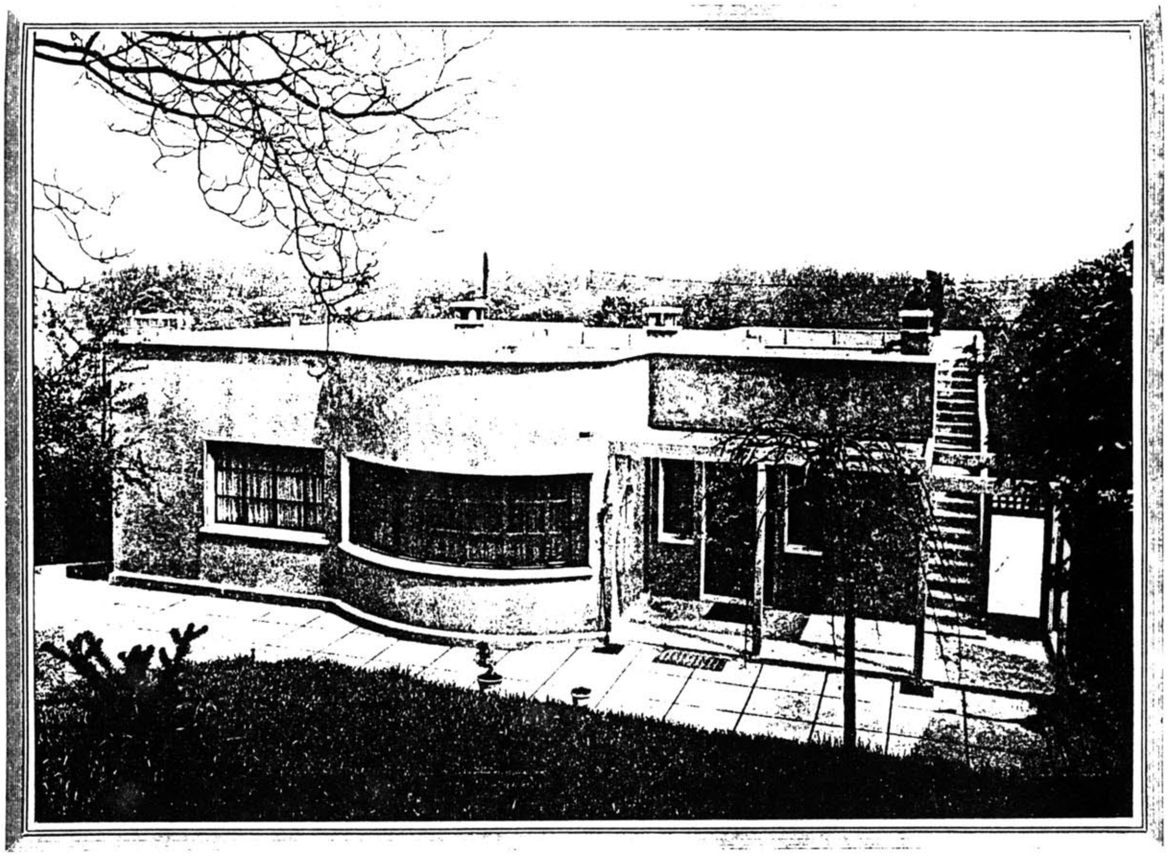


Fig.122. Jean-Charles Moreux
Villa de M. Brugier (built with the Decourt building system), 1928
Source: La Maison Isotherme. Procédés R. Decourt, (Nancy-Paris-Strasourg, 1930), p.35.

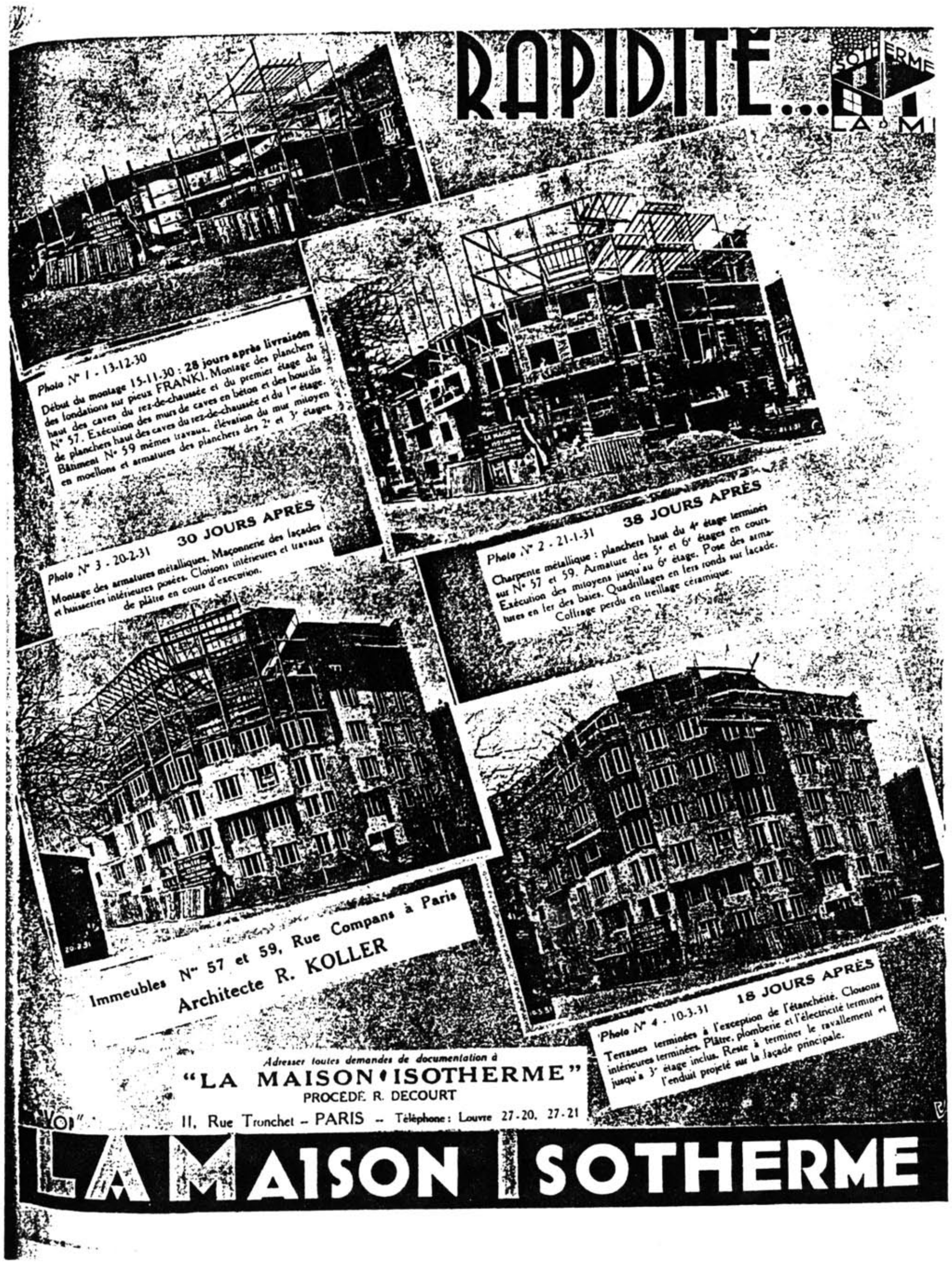


Fig.123. Raoul Decourt
Advertisement for Maison Isotherme, 1930
Source: La Maison Isotherme. Procédés R. Decourt, n.p.

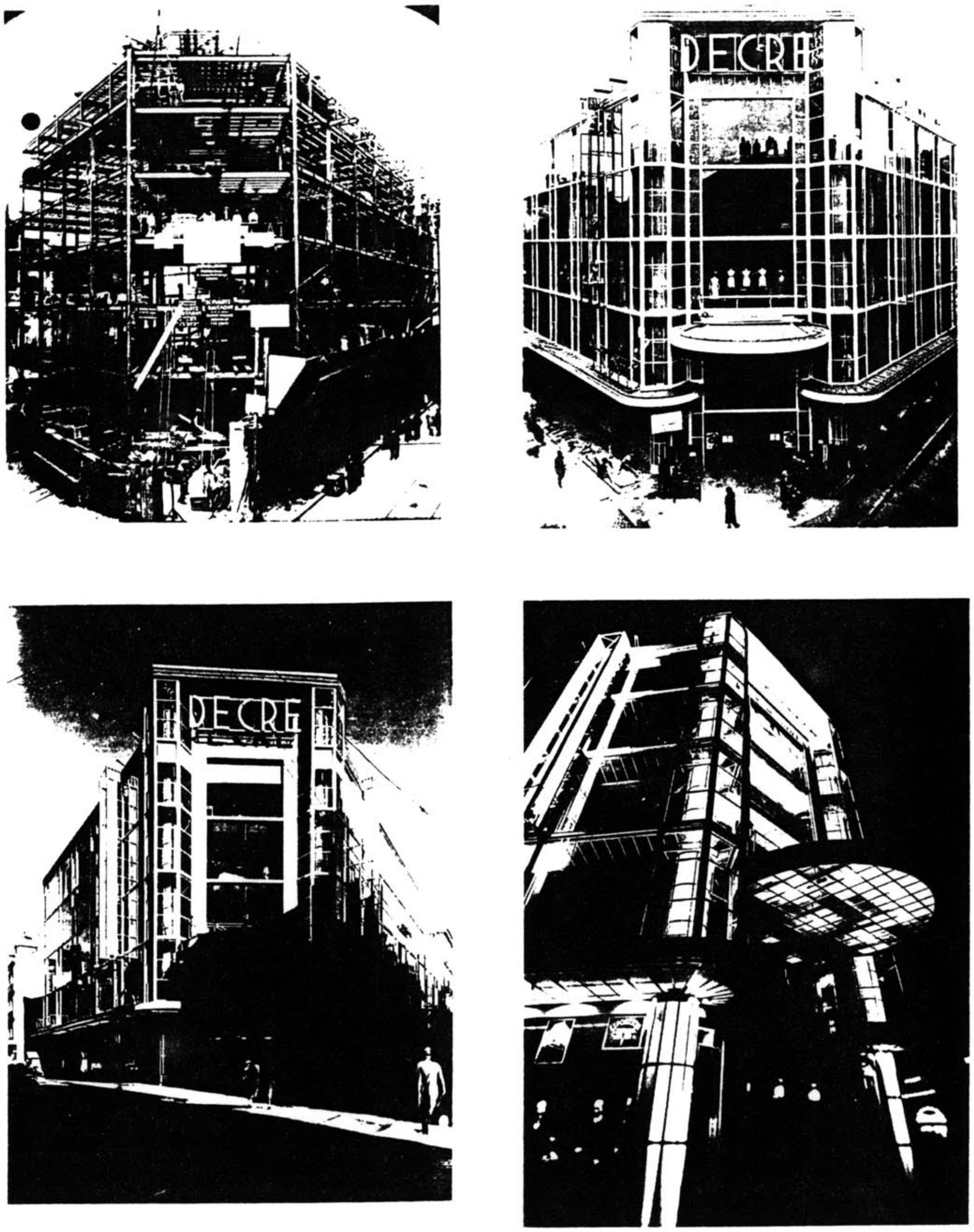


Fig.124. Henri Sauvage
Decré Department Store: views during and after construction, 1931
Source: The Architectural Drawings of Henri Sauvage, vol.2, p.509

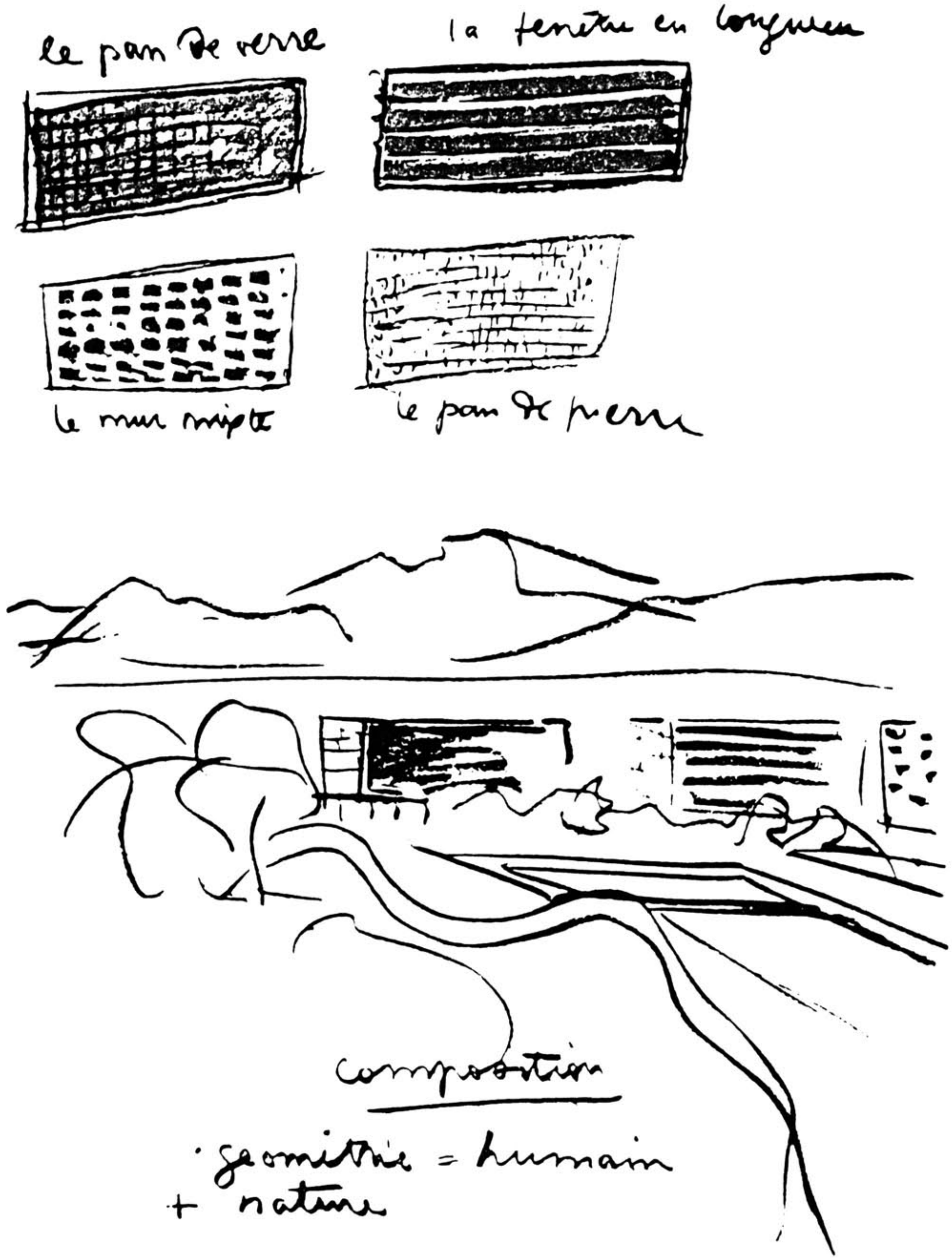
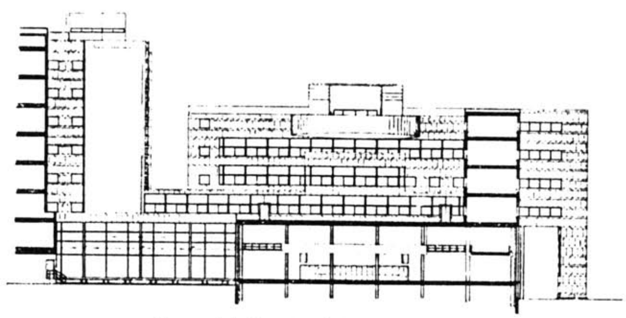


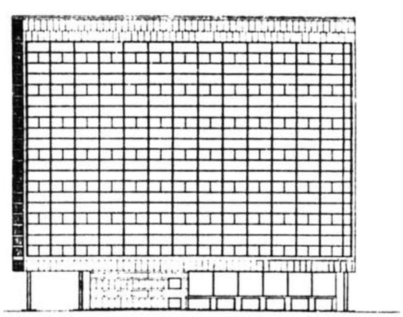
Fig.125. Le Corbusier
Sketches for wall systems, 1929
Source: Le Corbusier, Précisions, (Paris: Crès, 1930), p.59.

L'un des pignons en tuf du Caucase
Ce pignon doit être ravalé lisse



Coupe sur le hall, montrant la façade des restaurants

En chantier



Bâtiment D, façade principale

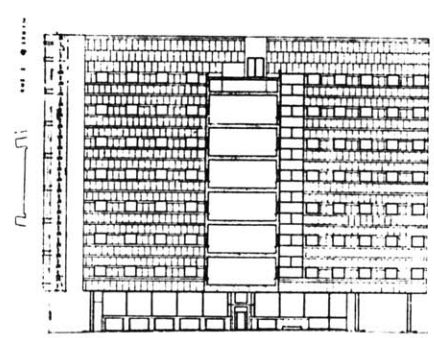


Fig.126. Le Corbusier
Palais du Centrosoyus, Moscow: views during and after construction, sectional elevations, and elevation, 1928-1934
Source: <u>Oeuvre Complète de 1929-1934</u>, p.41.

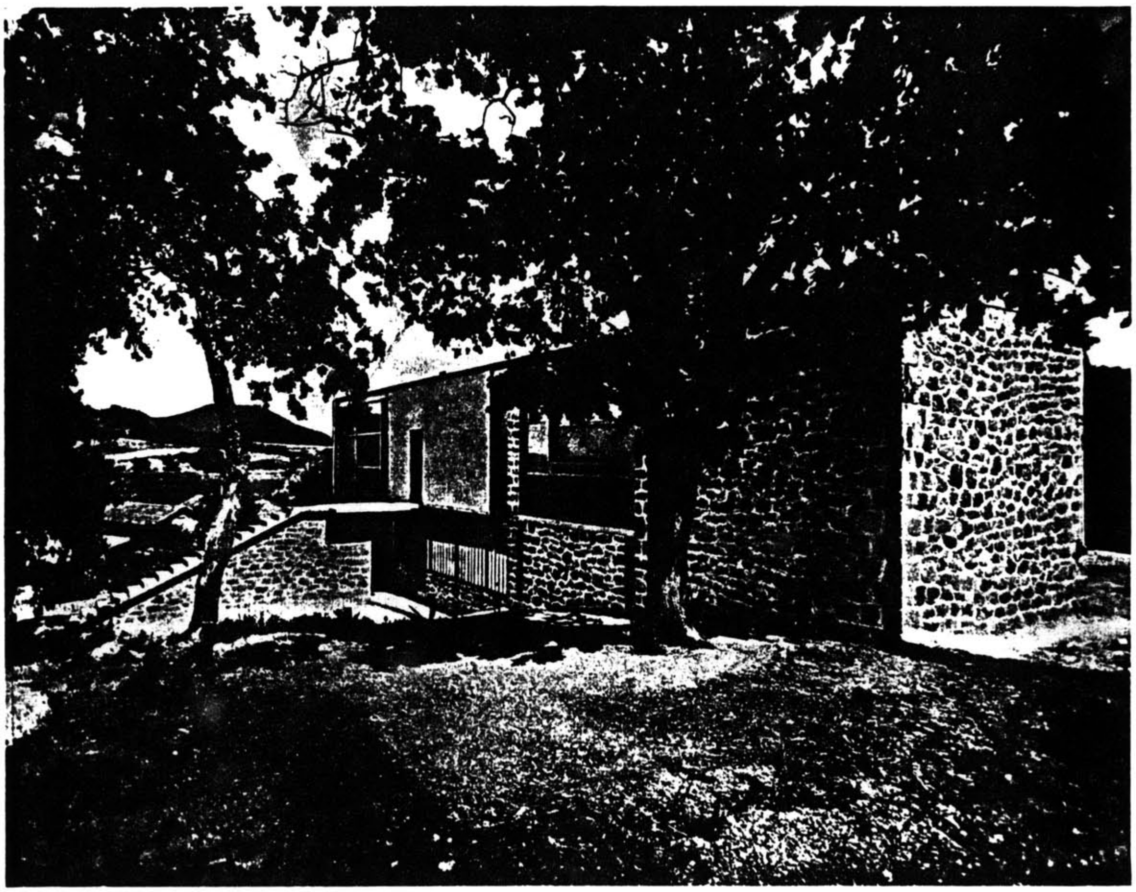


Fig.127. Le Corbusier
Maison de mandrot, 1930-1931
Source: Le Corbusier and Pierre Jeanneret, Oeuvre Complète de 1929-1934, (Zürich: Dr. H. Girsberger, 1935), p.58.

Fig.128. Le Corbusier
Pavillon Suisse: perspective, 1930-1933
Source: Oeuvre Complète de 1929-1934, p.75.

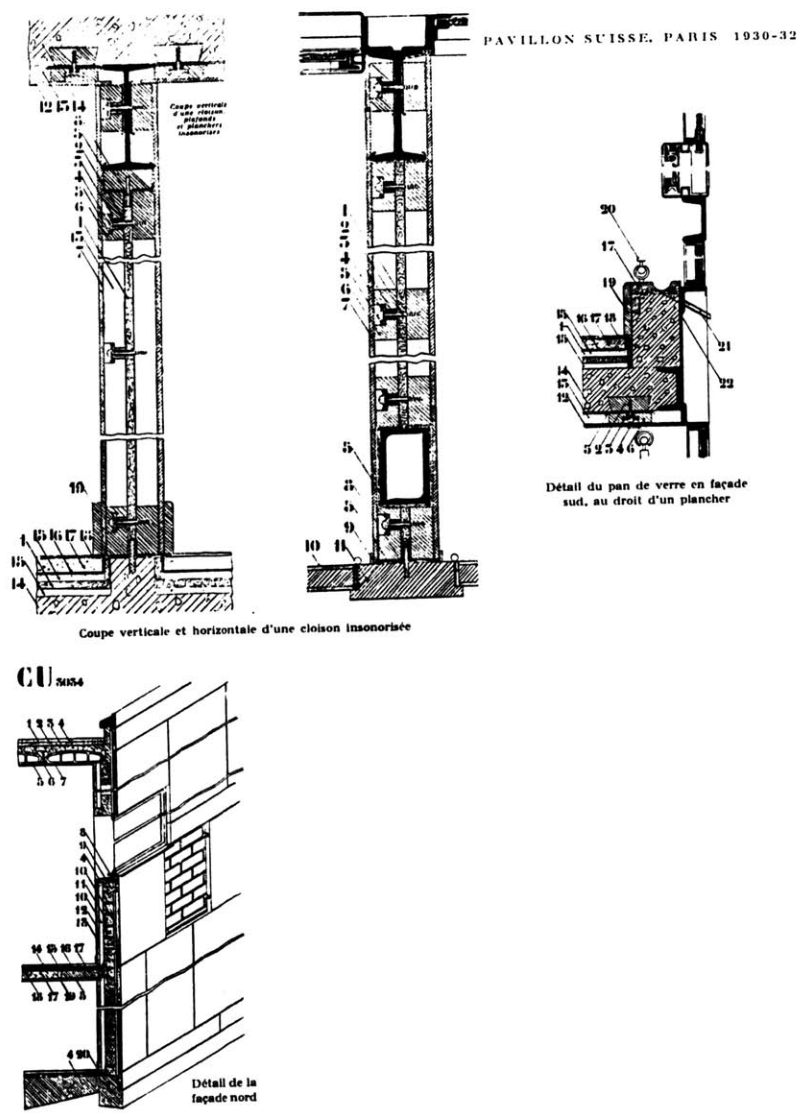


Fig.129. Le Corbusier
Pavillon Suisse: section of the wall system, 1930-1933
Source: Oeuvre Complète de 1929-1934, p.88.

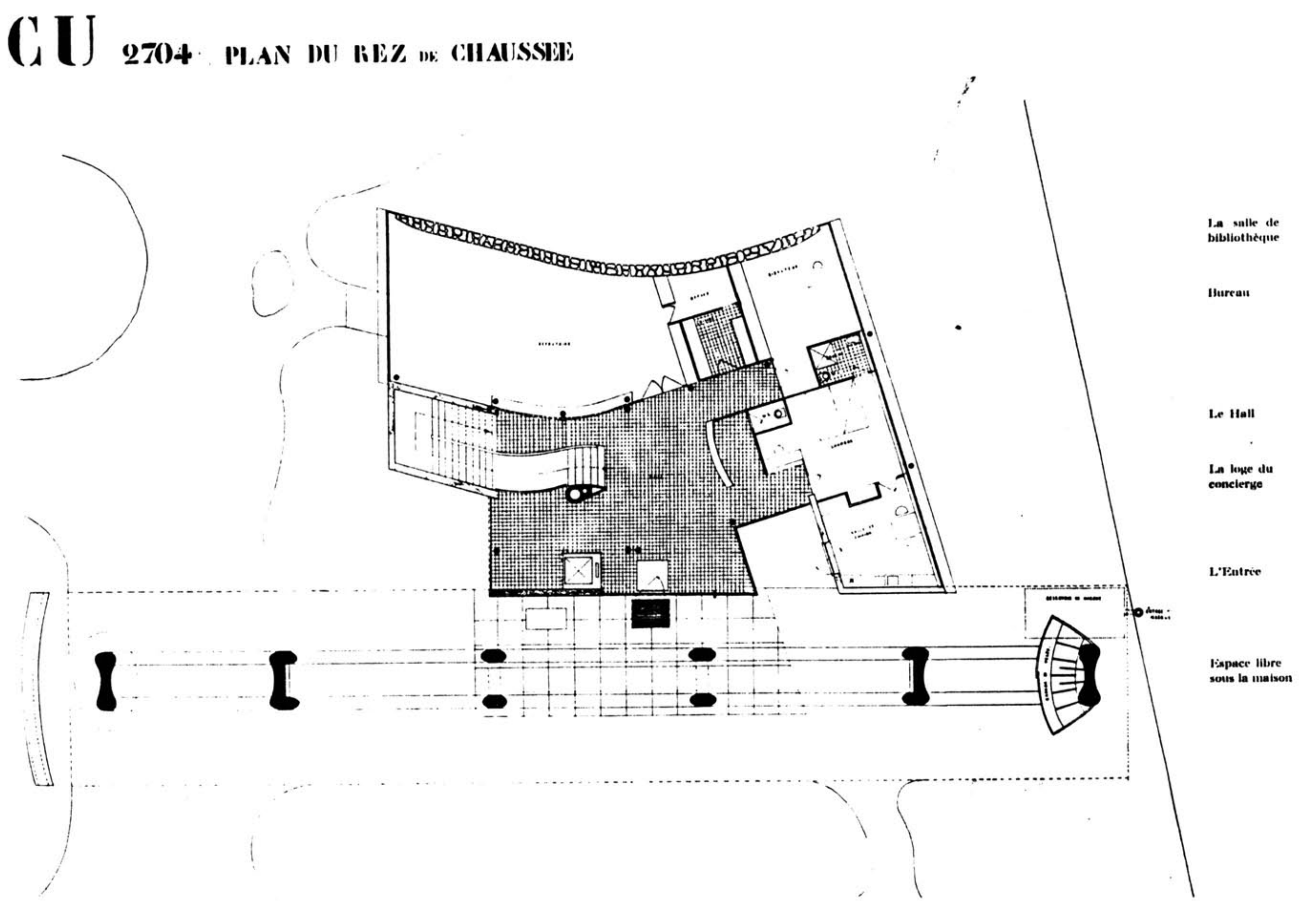


Fig.130. Le Corbusier
Pavillon Suisse: plan showing shape of concrete pilotis,
1930-1933
Source: <u>Oeuvre Complète de 1929-1934</u>, p.79.

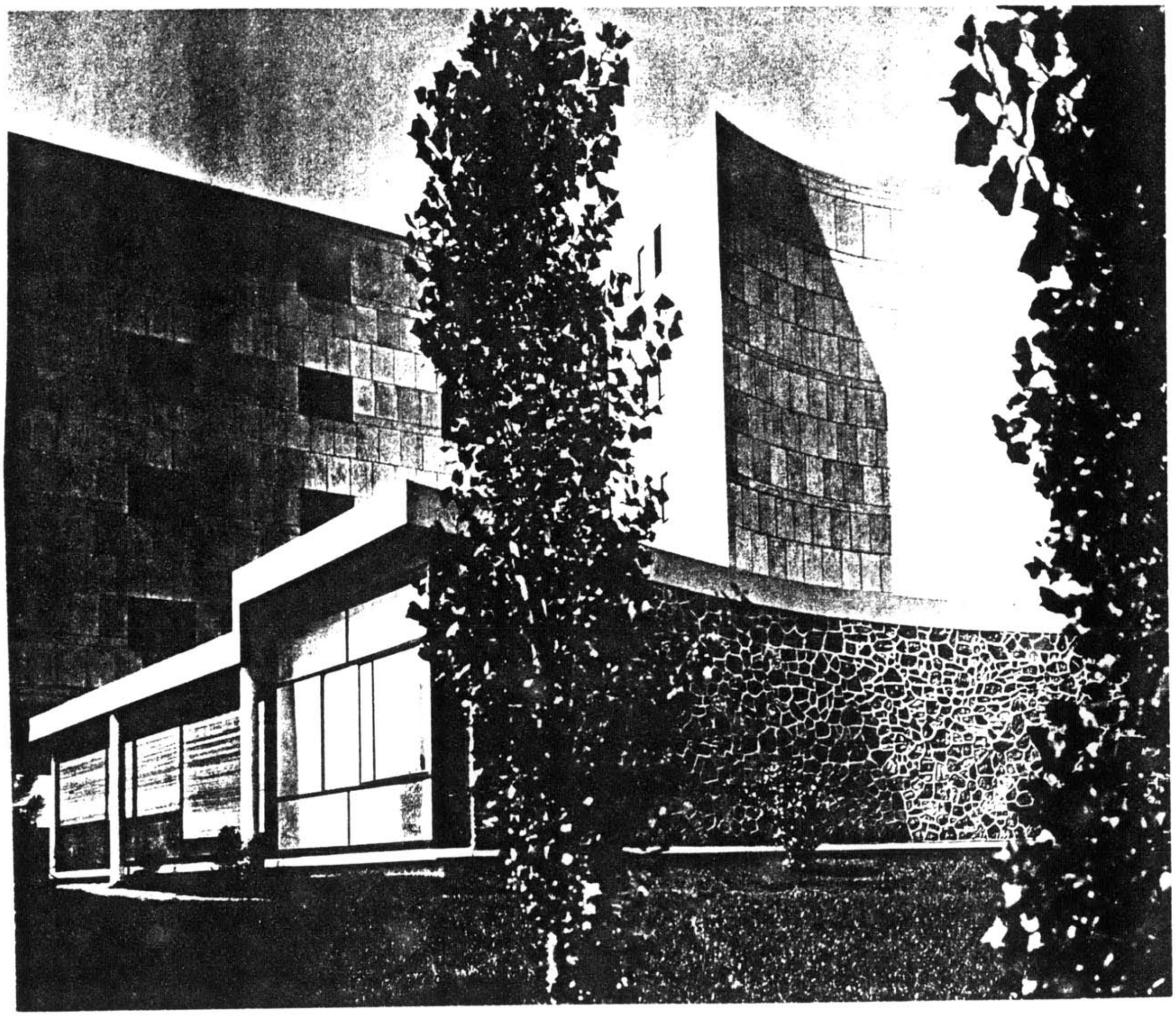


Fig.131. Le Corbusier
Pavillon Suisse: view of the ancillary block, 1930-1933
Source: Oeuvre Complète de 1929-1934, p.74.

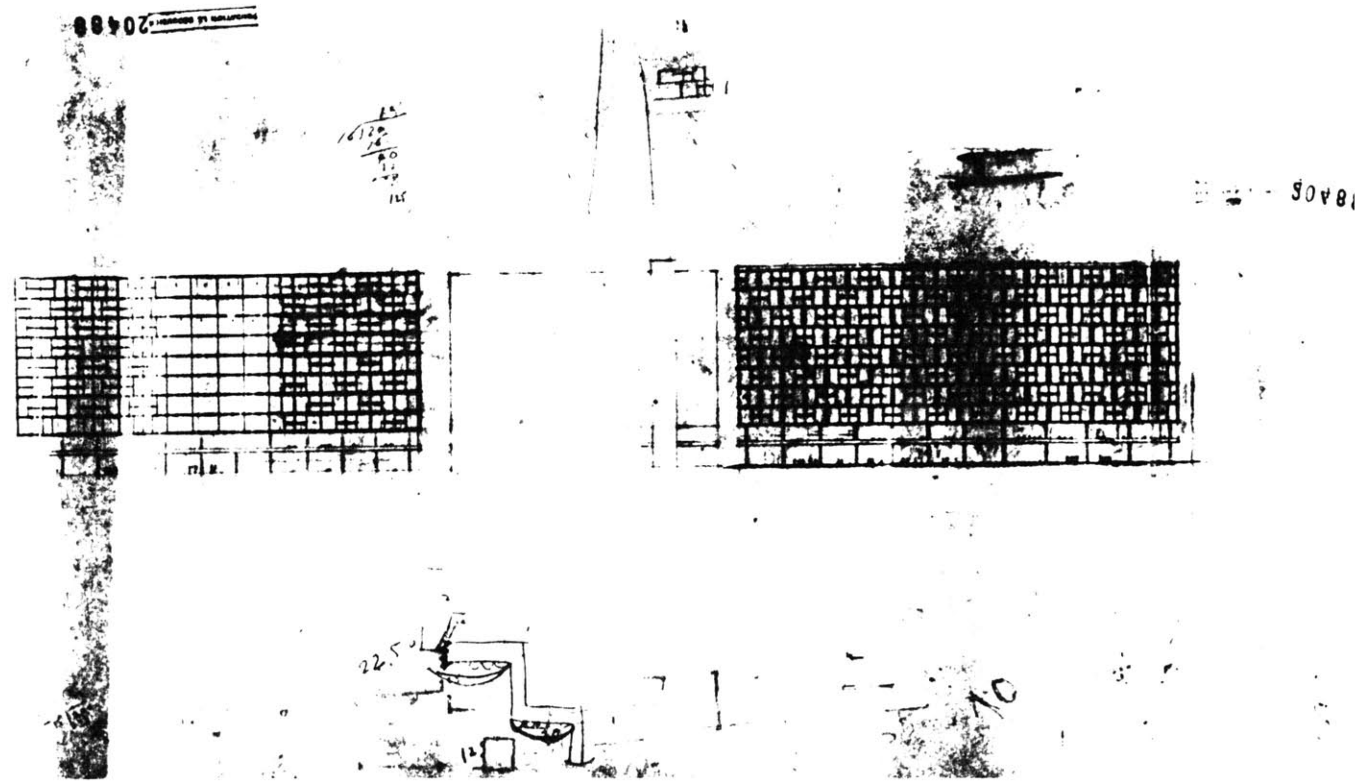


Fig.132. Le Corbusier
Project for residential buildings for the "Ville verte" plan for Moscow: studies for revetment, 1930
Source: Le Corbusier Archive, vol.8, p.503.

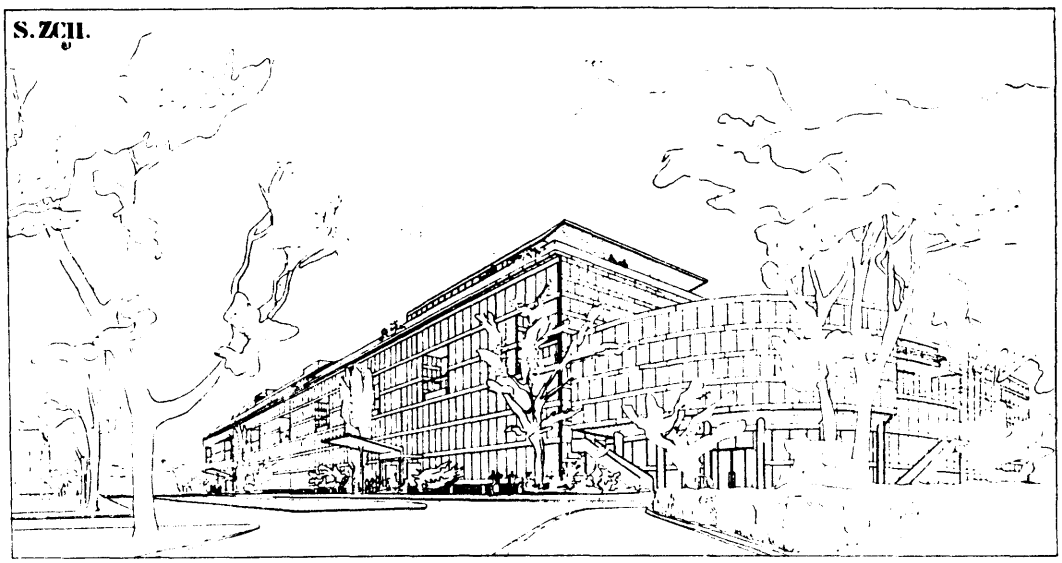
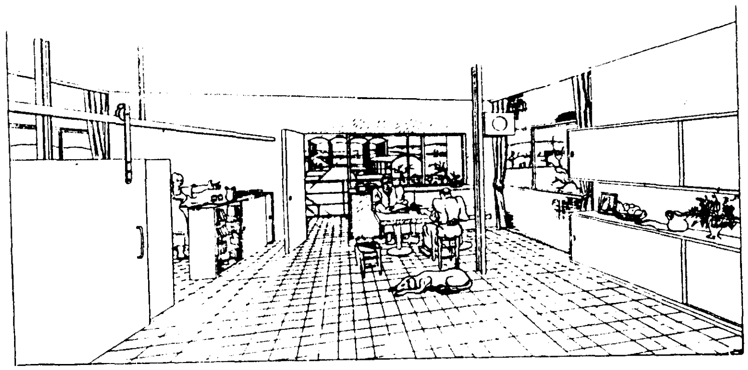
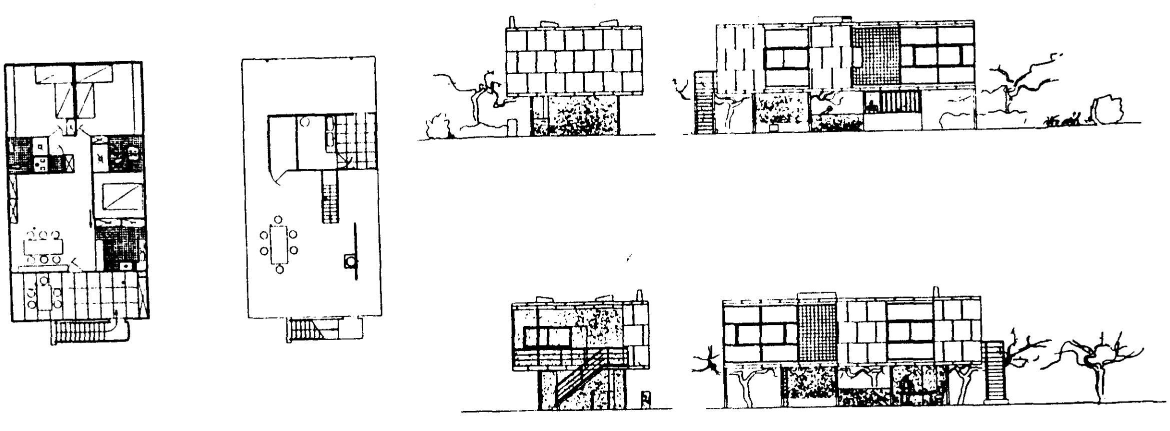


Fig.133. Le Corbusier
Project for a residential building in Zurich: perspectives, 1932
Source: Oeuvre Complète de 1929-1934, p.95.



La salle du logis



134. Le Corbusier
Réorganisation Agraire: interior perspective, elevations, and plans, 1934
Source: <u>Oeuvre Complète de 1929-1934</u>, p.188.

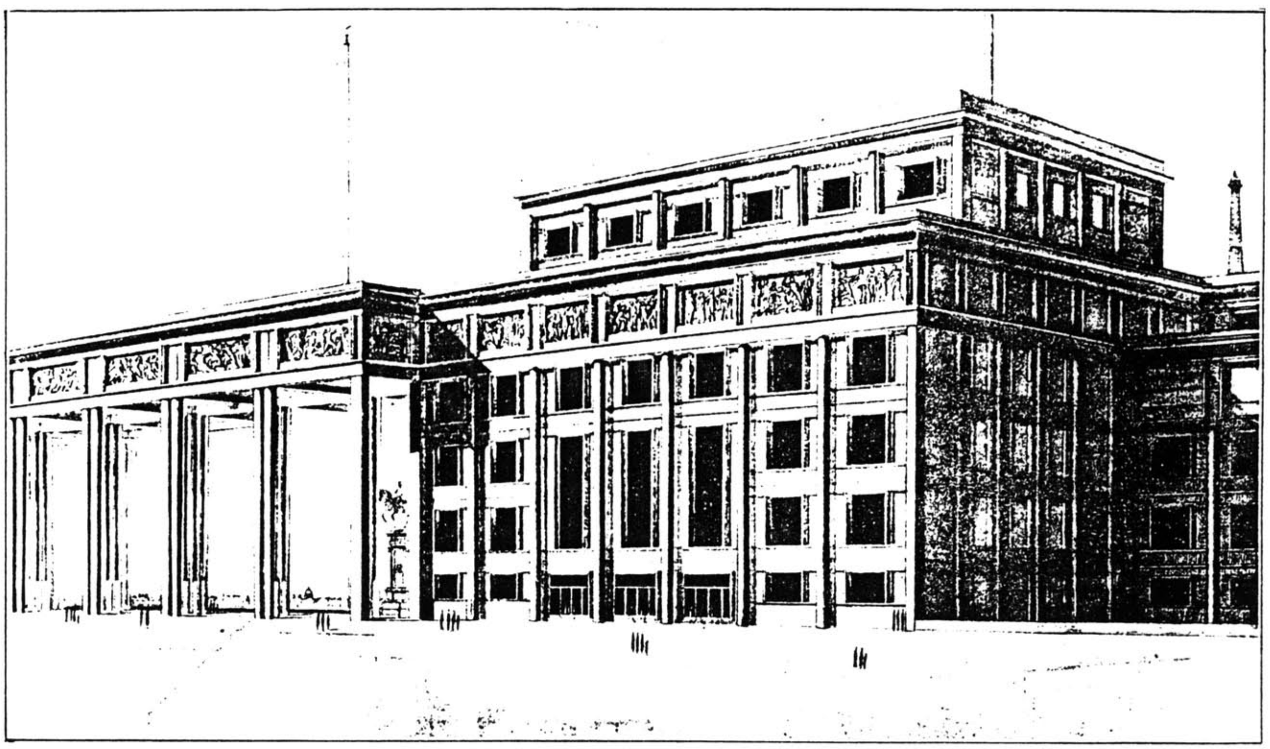


Fig.135. Auguste and Gustave Perret
Palais du Trocadéro: perspective howing the decorative low relief, 1934.
Source: Fonds Perret

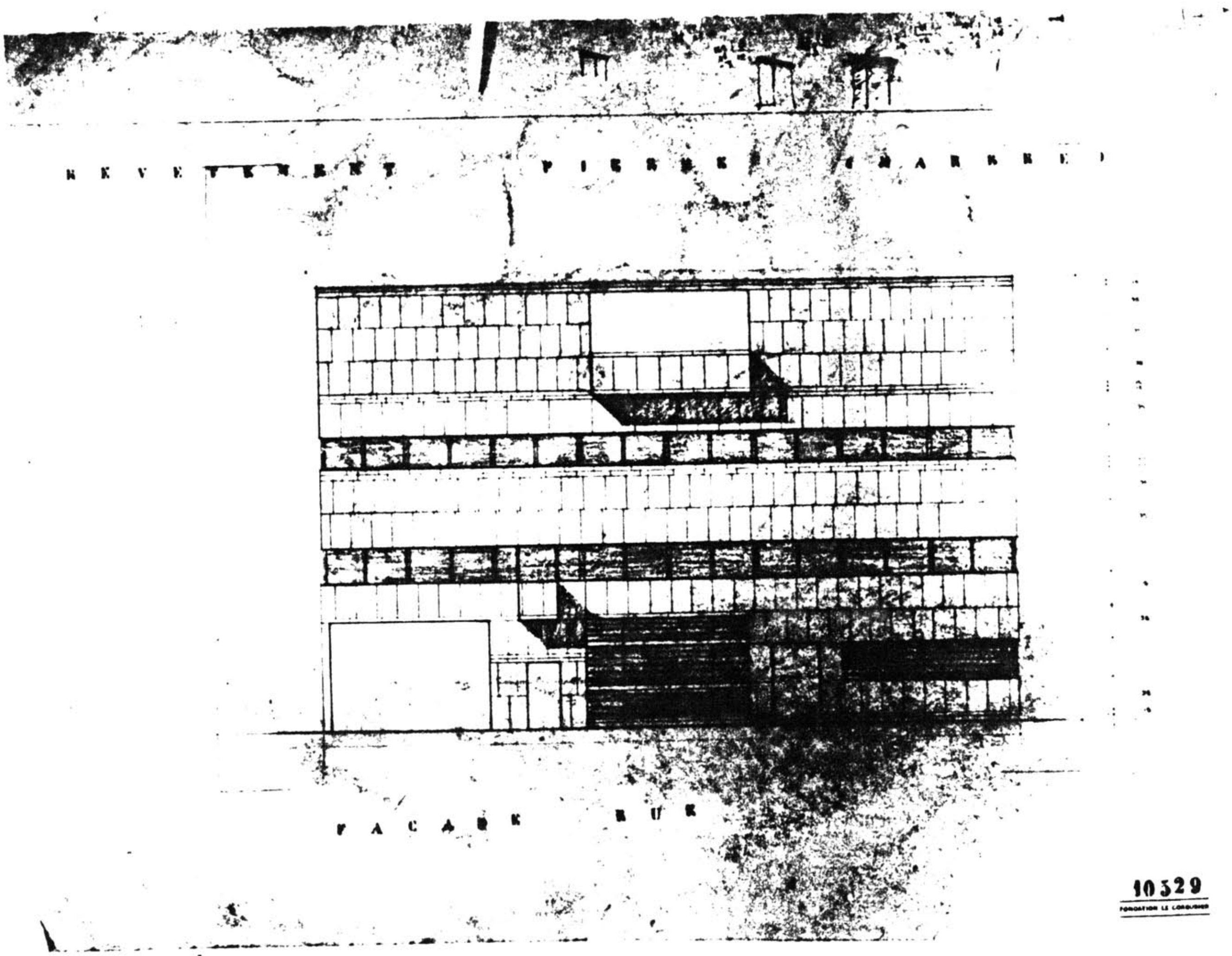


Fig.136. Le Corbusier
Villa at Garches: elevation showing the proposed external revetment in white marble, 1936.
Source: Le Corbusier Archive, vol.3, p.429.

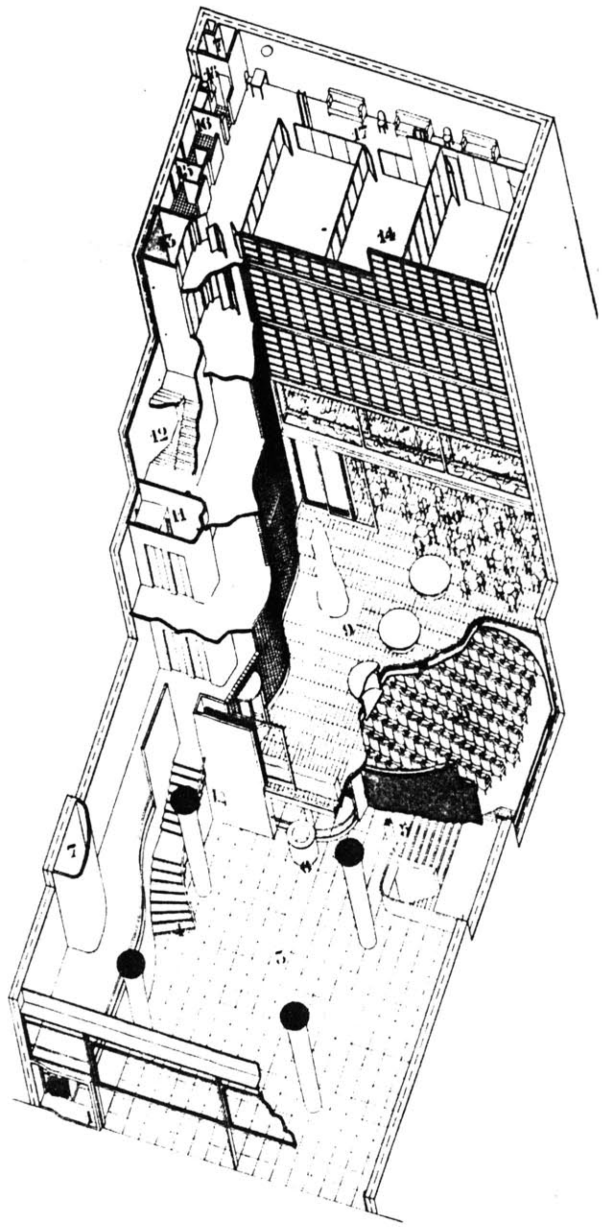


Fig.137. Oscar Nitzchké
Maison de la publicité: axonometric showing the metal-frame superstructure resting on the mushroom concrete columns of the ground floor, 1934
Source: Nitzchke Archive, in "Les Premiers Eleves de Perret", p.5.